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FROM

The Station

THIRTY-EIGHTH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE

1922

UNIVERSITY OF MAINE

1922

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MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

ORGANIZATION JANUARY TO JUNE, 1922

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WILLIAM G. HUNTON, Portland,	*Maine Seed Improvement Ass'n.*

AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS, AND THE DEAN OF THE COLLEGE OF AGRICULTURE

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AROOSTOOK FARM	....	*Associate Biologist*
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HIGHMOOR FARM	WELLINGTON SINCLAIR,	*Superintendent*
	....	*Scientific Aid*

*From April 12

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

ORGANIZATION JULY TO DECEMBER, 1922

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	PERLEY H. DOWNING,	*Superintendent*
HIGHMOOR FARM	....	*Scientific Aid*
	WELLINGTON SINCLAIR,	*Superintendent*

The publications of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

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ANNOUNCEMENTS.

ESTABLISHMENT OF THE STATION

The Maine Fertilizer Control and Agricultural Experiment Station, established by Act of the Legislature approved March 3, 1885, began its work in April of that year in quarters furnished by the College. After the Station had existed for two years, Congress passed what is known as the Hatch Act, establishing agricultural experiment stations in every state. This grant was accepted by the Maine Legislature by an Act approved March 16, 1887, which established the Maine Agricultural Experiment Station as a department of the University. The reorganization was effected in June, 1887, but work was not begun until February 16, 1888. In 1906, Congress passed the Adams Act for the further endowment of the stations established under the Hatch Act.

The purpose of the experiment stations is defined in the Act of Congress establishing them as follows:

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantage of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manure, natural and artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states or territories."

The work that the Experiment Station can undertake from the Adams Act fund is more restricted and can "be applied only to paying the necessary expenses for conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective states and territories."

INVESTIGATIONS.

The Station continues to restrict its work to a few important lines, believing that it is better for the agriculture of the State to study thoroughly a few problems than to spread over the whole field of agricultural science. It has continued to improve its facilities and segregate its work in such a way as to make it an effective agency for research in agriculture. Prominent among the lines of investigation are studies upon the food of man and animals, the diseases of plants and animals, breeding of plants and animals, orchard and field experiments, poultry investigations, and entomological research.

INSPECTIONS.

Up to the close of the year 1913, it had been the duty of the Director of the Station to execute the laws regulating the sale of agricultural seeds, apples, commercial feeding stuffs, commercial fertilizers, drugs, foods, fungicides and insecticides, and the testing of the graduated glassware used by creameries. Beginning with January, 1914, the purely executive part of these laws is handled by the Commissioner of Agriculture. It is still the duty of the Director of the Station to make the analytical examination of the samples collected by the Commissioner and to publish the results of the analyses. The cost of the inspections is borne by fees and by a State appropriation.

OFFICES AND LABORATORIES.

The offices, laboratories and poultry plant of the Maine Agricultural Experiment Station are at the University of Maine, Orono. Orono is the freight, express, post, telegraph and telephone address for the offices and laboratories.

AROOSTOOK FARM.

By action of the Legislatures of 1913 and 1915 a farm was purchased in Aroostook County for scientific investigations in agriculture to be under "the general supervision, management, and control" of the Maine Agricultural Experiment Station. The farm is in the town of Presque Isle, about 2 miles south of the village, on the main road to Houlton. The Bangor and Aroostook railroad crosses the farm.

The farm contains about 275 acres, about half of which is cleared. The eight room house provides an office, and home for the farm superintendent. A school house on a lot adjoining the farm was presented to the State by the town of Presque Isle and after being remodeled serves as a boarding house for the help. A greenhouse and a potato storage house have been erected at the farm by the U. S. Department of Agriculture for use in cooperative work on potato breeding. The large barn affords storage for hay and grain and has a large potato storage house in the basement.

HIGHMOOR FARM.

The State Legislature of 1909 purchased a farm upon which the Maine Agricultural Experiment Station was directed to "conduct scientific investigations in orcharding, corn and other farm crops." The farm is situated largely in the town of Monmouth. It is on the Farmington Branch of the Maine Central Railroad, 2 miles from Leeds Junction. A flag station, "Highmoor," is on the farm.

The farm contains 225 acres, about 200 of which are in orchards, fields, and pastures. There are in the neighborhood of 3,000 apple trees upon the place which have been set from 20 to 30 years. The house has 2 stories with a large wing, and contains about 15 rooms. It is well arranged for the Station offices and for the home of the farm superintendent. A substantially constructed building for apple packing was erected in 1912.

The removal of the crossbred herd from the University to Highmoor necessitated considerable change in the barns and the building of a new one 80 x 36 to accommodate the herd. This barn has a basement for manure, the cow stanchions above, and a loft for storage of hay.

PUBLICATIONS.

The Station is organized so that the work of investigation is distinct from the work of inspection. The results of investigation are published in the bulletins of the Station and in scientific journals, both foreign and domestic. The bulletins for the year make up the annual report. The results of the work of inspection are printed in publications known as Official Inspections. These are paged independently of the bulletins and are bound in with the annual report as an appendix thereto. Miscellaneous publications consisting of newspaper notices of bulletins, newspaper bulletins and circulars which are not paged consecutively and for the most part are not included in the annual report are issued during the year.

BULLETINS ISSUED IN 1922.

No. 305. The Relation of Tree Type to Productivity in the Apple. 20 pages. 4 pages of plates.
No. 306. Studies in Milk Secretion. XVII. Relation between Milk Yields and Butter-Fat Percentages of the 7-day and 365-day Tests of Holstein-Friesian Advanced Registry Cattle. 40 pages.
No. 307. Sterility Relationships in Maine Apple Varieties. 16 pages.
No. 308. The Blueberry Maggot in Washington County. 16 pages. 1 page of plates.
No. 309. Abstracts of Papers not Included in Bulletins, Finances, Meteorology, Index. pages.

OFFICIAL INSPECTIONS ISSUED IN 1922.

No. 103. Foods and Drugs. 24 pages.
No. 104. Commercial Feeding Stuffs, 1921-22. 20 pages.
No. 105. Commercial Fertilizers, 1922. 32 pages.
No. 106. Commercial Agricultural Seeds, 1922. Insecticides and Fungicides, 1922. 24 pages.

PUBLICATIONS FROM THE BIOLOGICAL LABORATORY IN 1922.

Sterility in Wheat Hybrids. II. Chromosome Behavior in Partially Sterile Hybrids. By Karl Sax. Genetics, Vol. 7, pp. 513-552, November, 1922.
Sterility in Wheat Hybrids. III. Endosperm Development and F_2 Sterility. By Karl Sax. Genetics, Vol. 7, pp. 553-558, November, 1922.

PUBLICATIONS FROM THE ENTOMOLOGICAL LABORATORY IN 1922.

Aroostook Potato Insects. By Edith M. Patch, Journal of Economic Entomology, Vol. 15, p. 373. October, 1922.

STATION NOTES

COUNCIL AND STAFF CHANGES

At the annual spring meeting of the Station Council on April 12, 1922, Dr. Clarence C. Little, President of the University, was elected president of the Council to succeed Dr. Robert J. Aley, resigned.

Mr. E. Raymond Ring, Superintendent of Aroostook Farm for three years and for one year Scientific Aid in connection with the plant breeding work at the Farm resigned on April 1 to accept a similar position with the Rockefeller Institute for Medical Research at Princeton, N. J. In temperament, training and experience Mr. Ring possessed exceptional qualifications for a position of this kind and his resignation was a distinct loss to the Station. Mr. Perley H. Downing was appointed to succeed him.

Mrs. Estelle M. Goggin resigned as Clerk in the Station office on July 1 and Miss Ila K. White was appointed to a similar position on that date. Mrs. Beatrice G. Webster resigned as Laboratory Assistant in Biology on December 1.

BULLETIN 305

THE RELATION OF TREE TYPE TO PRODUCTIVITY IN THE APPLE.[1]

KARL SAX AND JOHN W. GOWEN.

SUMMARY

A study of 881 trees in Ben Davis Orchard No. 1 at Highmoor Farm, shows that trees of the same age and even under apparently identical environmental conditions may vary enormously in productivity.

Productive and unproductive trees are closely associated with a definite type of habit of growth. The productive or Type 1 trees are large, open and spreading with short laterals and bear many spurs. The unproductive or Type 3 trees are small and upright with slender branches and few spurs. Between these two extreme types are a number of intermediate types.

An analysis of cost of production for 1914 shows that in our Ben Davis orchard a tree must produce approximately 108 lbs. of fruit to return a profit. On this basis 29% of the 881 trees were kept at a loss. Most of the unprofitable trees were of Types 3 and 3-2. Type 3 trees were kept at an average loss of 90 cents while Type 1 trees were kept at an average profit of $2.30.

The primary causes of differences in productivity of fruit trees may be attributed to soil, root stocks, or differences in scions. Soil was found to play an important part in causing differences in yield as indicated by the natural grouping together of unproductive trees. Of the 257 unprofitable unproductive trees about 65% are apparently due to soil conditions. Unproductive trees surrounded by only productive trees are unproductive due primarily to unfavorable root stocks, inherent differences in scions of the clonal variety or factors other than soil. The percent-

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[1] Papers from the Biological Laboratory, Maine Agricultural Experiment Station, No. 151.

A more technical presentation of the same subject may be found in the Journal of Heredity, v. xii, no. 7.

age of such trees is about 35% of all unprofitable trees. There is no critical evidence that there are inherent differences in yields of apple trees of a clonal variety due to bud mutation. In all cases when scions have been selected from productive and unproductive apple trees there has been no increased yields of the scions from productive trees. There is evidence that variable root stocks may cause differences in yield of fruit trees and that unproductive trees may often be attributed to unfavorable root stocks.

If apple trees are unproductive due to soil conditions it is possible that they can be made more productive by application of commercial fertilizer. We have, however, found no influence of even heavy applications of a complete fertilizer on our Ben Davis orchard during a 6 year period. The addition of fertilizer to other varieties or the addition of other forms of fertilizer may cause inceased yields, but increased yields may not mean more profitable trees under such conditions.

A digest of the evidence shows that inherent differences in productivity are rarely or never present in clonal varieties of apple trees. Such being the case little justification exists for top working unproductive trees with scions from productive trees.

Unfavorable root stocks probably cannot be remedied in a mature orchard but they can be avoided to a considerable extent in a new orchard by selecting only large, vigorous, rapid growing nursery stock, as the evidence shows that small nursery trees usually result in small trees in the orchard. The best grade of one year old trees are recommended because their large size is due to ability to make good growth and not due to age. The establishment of clonal varieties of unusually favorable root stocks would undoubtedly result in more uniform and in general more productive trees.

INTRODUCTION

In animal husbandry work it has long been recognized that within the flock or herd there are individuals which return a large profit, individuals which return a small profit, and individuals which are kept at a loss. By a study of the external characters making up the conformation of these profitable and unprofitable groups of animals it has been possible to show that certain of these characters bear a relationship to the productivity of the animal. By the use of these external characteristics it is possible to choose the animals whose production is high from those whose production is low. Little attention has been given to the differences in productivity of fruit trees. Unproductive trees are not easily discovered because the absence of fruit in any given year may be attributed to the "off-year" for the tree. Only annual records of the yields of individual trees or a method of classifying productive and unproductive trees by a study of tree type will enable the unprofitable trees to be detected. By the use of these annual records and by a careful study of the conformation of the apple trees in our Ben Davis orchard, it has been possible to show that there is a high association between certain tree types and the yield of fruit which they bear. In this paper data will be presented to show this relation between type of tree and yield, the probable cause of the various types, the loss sustained by the grower in keeping certain inferior types. The available methods by which these unprofitable trees may be eliminated will also be discussed.

MATERIALS AND METHODS.

The data for the present study were obtained from Ben Davis Orchard No. 1 at Highmoor Farm, Monmouth, Maine. The orchard contains 1235 trees but on discarding injured or reset trees there are left 881 trees for analysis. These trees are set 25 x 25 feet. They are about 28 years old. During the time the records were taken the trees were well cared for and were relatively free from disease. The trees were given row and tree numbers which were printed on metal tags and attached to the tree.

The soil in the orchard is not uniform. There are wet areas along the south side and in the northwest quarter, while the southwest quarter of the orchard is high and sandy. Fertilizer and cultivation experiments have been conducted on various parts of the orchard, but we have been unable to detect any results of such treatment.

Records of yield and growth of each tree have been kept since 1913. The fruit from each tree was weighed each year and measurements of the trunks in circumference were made each fall after the apples were picked. The weighing apparatus used in this work is shown in Figure 1. With this device one man can weigh and record the fruit picked by a crew of 10 to 15 men. Since one man can weigh the fruit and at the same time supervise the picking crew the cost of obtaining the tree yields is not excessive. The data were recorded in a permanent book and later punched on cards for analysis.

The recording of the data until 1918 was done under the direction of Dr. Frank M. Surface. Much credit is due Doctor Surface for the initiation of the work and for the careful manner in which the records were kept. The presence of various types of trees and the general relation of tree type and yield was first noticed by Mr. Walter Curtis, former scientific aid at Highmoor Farm. The trees were classified into the various types by Walter Curtis and the late Doctor Jacob Zinn, associate biologist of this station.

TYPES OF BEN DAVIS TREES.

A study of variation in the habit and amount of growth of Ben Davis trees reveals two principle contrasting types, type 1 and type 3, and certain intermediate types intergrading between the two main types.

Type 1 is a strong vigorous tree with a large head. The form of the head is open and spreading The general appearance of this type suggests great productivity and vigor. The main branches are very large, ramifying profusely, especially in the upper regions where they form numerous short, stout laterals and twigs bearing many spurs. The branches especially in the lower region of the tree, are drooping thus increasing the volume of the head. The twigs are rather short, stout and slightly crooked. The characteristic feature of this type is the differentiation of the large branches into many laterals bearing an abundance of spurs. The type is well shown by tree 13, row 21. (Fig. 2.) This tree bore 922.3 lbs. of fruit in the period 1914-20.

Type 3 is a medium sized tree with a rather small head. The form of the head is upright but not spreading. The branches are of medium size near the trunk but are very slender at the top. The ramification of the branches is sparse and limited to regions at the base. The characteristic feature of this type is the upright slender branches. The twigs are willowly, very slender, long and upright with few spurs. Type 3 is illustrated by tree 13, row 2.

(Fig. 3.) This tree bore only 81.8 lbs. of fruit in the 7 years, 1914-20.

Between type 1 and 3 are a number of integrading types whose position in the series is determined by the resemblance to the types described above. Type 2 may be regarded the center around which are grouped the other types in the series. Type No. 2 is characterized by a vigorous growth, spreading head, stout numerous and drooping branches. It differs from Type 1 in that it has longer laterals and fewer spurs. Type 2 grades off to type 1 through types 2-1 and 1-2, the latter approaching type 1. Similarly, the distance between type 2 and 3 is bridged by type 2-3 and 3-2 the former approaching type 2 ,the latter type 3. Type 2 is shown in Fig. 4.

RELATION BETWEEN TREE TYPE AND YIELD.

In general trees of type 1 are the most productive and the average productivity decreases for the intermediate types as they approach Type 3. Type 3 is very unproductive, and even in the most favorable year the trees of this type bore an average of little more than one bushel of fruit per tree. The 1914 distribution of the yields of the various types together with the means and degrees of variability are shown in Table 1.

The average yield of the 121 trees of type 1 was 283.7 lbs. or more than 2 bbls. per tree while the average yield of the 136 trees of type 3 was only 40.1 lbs. or less than a third of a barrel per tree. The 233 trees of type 2 averaged 190.3 lbs. or nearly a barrel and a half per tree in 1914. Of the total number (881) of trees more than one-third produced less than one barrel per tree due largely to the presence of unproductive types of trees.

The same relative relation between tree type and yield is shown in the years 1915-18 as was found in 1914 although the total yields are in no case as high as in 1914. The average yield for type 1 trees varied from 117.6 lbs. per tree in 1917 to 220.6 lbs. per tree in 1915. Type 3 trees produced an average of 27.1 lbs. of fruit in 1917 and 47.8 lbs. of fruit in 1915. For the five year period 1914-18 the type 1 trees averaged nearly 1.5 bbls. of fruit per tree annually while the type 3 trees bore an average of less than 0.3 bbls. per tree.

In the tables given above it is evident that the trees of type 1 are the most productive and that the productivity decreases as the

TABLE 1.

Yields of the Various Types of Apple Trees.

Yield 1914.

	Yield in Pounds of Fruit																										
Type	0-20	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460-480	N	Mean	Standard Deviation	Coefficient of Variation
1							3	4	3	6	5	6	19	11	14	16	6	13	7	1	2	3	2		121	283.72±4.31	70.32±3.05	24.79±1.14
1-2						1	1	6	5	5	11	6	14	6	8	6	5	1		1	1				77	243.25±4.67	60.78±3.30	24.99±1.45
2-1				1	3	4	4	9	18	9	12	17	11	11	10	8	7	4	2					1	131	228.01±4.17	70.80±2.95	31.05±1.41
2	1	2	9	5	10	10	18	24	24	14	33	24	25	13	9	3	7	1		1					233	190.34±3.13	70.85±2.21	37.22±1.31
2-3	3	5	7	9	8	7	9	11	14	10	7	3	2	3	2	1									101	139.70±4.65	69.32±3.29	49.62±2.88
3-2	9	10	14	9	12	4	6	5	7	1	1	2		2											82	89.76±4.67	62.66±3.30	69.81±5.17
3	51	33	27	11	7	2		1	2			1		1											136	40.15±2.35	40.58±1.66	101.09±7.21
Total	64	50	57	35	40	28	41	60	73	45	69	59	71	47	43	34	25	19	9	3	3	3	2	1	881	175.20±2.32	102.32±1.64	58.40±1.22

intermediate types approach type 3. Tree type is closely associated with yield and also with size of tree. As a rule the unproductive trees are small and of type 3, while the productive trees are large and of type 1. In general the trunk girth of a tree is a fairly reliable index of its productivity.

THE CAUSE OF VARIOUS TREE TYPES.

Consistantly unproductive trees have often been attributed to inherent differences resulting from bud mutation. In other words certain varieties are thought to contain high and low yielding strains of trees. There are, however, a number of factors which may cause consistent differences in the productivity of trees in the same orchard. Soil heterogeneity, including such permanent differences as soil moisture, depth of soil, elevation, and physical and chemical properties of the soil, may cause certain trees to yield more than others from year to year. Root stocks are grown from seed. These seeds are of widely different origin, are undoubtedly crossed fertilized and consequently considered from the genetic standpoint are highly heterozygous, each tree making up the whole number of stocks being far from comparable with its neighbor. Under such conditions it is to be expected that such stocks vary widely in their ability to produce vigorous, high yielding trees, when budded or grafted to scions from a given clonal variety. The influence, favorable or unfavorable, of root stock constitute the second variable affecting the productivity of the mature tree. No such heterozygosity exists in the bud or scion. These buds or scions are selected from a clonal variety asexually reproduced. It has, however, been frequently asserted, on the basis of what the authors believe to be uncritical evidence, that bud variations affecting yield frequently occur within a clonal variety. The evidence for or against this supposition is reviewed and makes the third possible variable which might conceivably influence yield. No consideration is given to differences in yield due to injury by disease or insects, because in this Ben Davis orchard at least during the period covered by this record these factors are of minor importance. The various known factors which may cause consistent and significant differences in productivity of trees of a clonal variety will be considered in the following order,—1. Soil heterogeneity. 2. Root stocks, and 3. Bud mutation.

VARIABILITY IN PRODUCTIVITY, DUE TO SOIL HETEROGENEITY.

If differences in productivity are due to variable root stocks or variable scions we would expect a random distribution of high and low yielding trees throughout the orchard. If soil variability is the cause of differences in performance we would expect to find the high and low yielding trees in rather definite groups. It is hardly possible that soil differences can be so local in extent as to affect the productivity of but a single tree. Frequently an unproductive tree will be found entirely surrounded by comparatively productive ones. We have dug up several of these trees and in every case the root system of the unproductive tree was so interwoven with the root systems of the productive trees that they had to a great extent a common feeding ground. In no case was the isolated, unproductive tree in apparently poorer soil than the productive trees. We can expect then that high and low yielding trees will be grouped if tree variability is due to soil.

TABLE 2.

Distribution of types of trees in Ben Davis Orchard. Showing in each block the total number of trees, number and percentage of Type 1, and number and percentage of Type 3. Further explanation in text.

N.

33-	28 — 4-14	12 0— 2-17	8 — —	1 — —	0 — 0—
25-32	62 4-6 5-8	59 6-10 —	49 2-4 2-4	43 5-12 1-2	25 3-12 2-8
17-24	64 8-12 4-6	60 4-7 2-3	56 9-16 4-7	36 15-42 1-8	31 5-16 4-13
9-16	63 20-32 3-5	63 16-25 2-3	51 5-10 2-4	41 18-44 4-10	33 2-6 3-9
Trees 1-8	51 3-6 15-29	57 8-14 15-26	56 1-2 26-46	49 2-4 27-53	33 1-3 17-52
Rows	1-8	9-16	17-24	25-32	33-37

S.

Ben Davis orchard No. 1 contains 37 rows with 29 to 37 trees per row. The orchard was divided into 25 blocks as shown in Table 4. The number of trees per block varies considerably due to missing or replanted trees, or to variations in rows or trees per row included in certain blocks. The distribution of the extreme types of trees is readily observed in Table 2.

The total number of trees, the number and percentage of type 1 trees, and the number and percentage of type 3 trees for each block are shown. Thus in the block of trees including rows 1-8 and trees 1-8 we find a total of 51 trees. Of these 51 trees, 3 or 6% are of type 1, while 15 or 29% are of type 3. A study of the distribution of the two extreme types, 1 and 3, shows that they are in rather definite areas of the orchard. Most of the type 3 or unproductive trees are located along the west side of the orchard and especially towards the south end of this area. The location of the unproductive trees coincides very closely with the high sandy portion of the orchard. Clearly the grouping of the unproductive trees is due to unfavorable soil conditions or exposure. The type 1 or productive trees are grouped largely in the west-central part of the orchard, especially in the blocks including rows 1-16, trees 9-16, and the blocks including rows 25-32, trees 9-24. In these four blocks the percentage of type 1 trees varies from 25% to 44%. The grouping of productive trees in definite areas can only be attributed to unusually favorable soil conditions in these areas.[2]

VARIABILITY IN PRODUCTIVITY DUE TO ROOT STOCKS.

It is clear that the various types of trees, productive and unproductive, are due to a considerable extent to soil heterogeneity. It is also evident that an unproductive type of tree when surrounded by productive type, all having a more or less common feeding ground, cannot be attributed to unfavorable soil. The behavior of such trees indicates that the various types of trees may be caused to some extent at least by one or both of the other factors mentioned, i. e., root stocks or bud variation. We will consider next the influence of the root stock on type and yield.

It is well known that seedlings grown for root stocks are extremely variable both in regard to morphological characters and growth. In our seedling orchard 586 trees which were planted in 1911 vary in circumference from 2 to 18 c.m. and the coefficient of variability was found to be 32.07±.69. Such great variability would be expected in the growth of seedling apple trees since all apple trees are more or less heterozygous and are usually cross pollinated.

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[2] The soil in our Ben Davis orchard was also found to be heterogeneous when measured by the test for soil heterogeneity proposed by Harris (4). For the average soil heterogeneity based on the yields of the 881 trees for 1914-18, r=.40. The individual tree was used as the ultimate unit and trees were grouped in a four by four fold manner for the combination plots.

So-called "standard stocks" may vary greatly in growth. Hatton (5) found about 14% of a block of "free stock" seedlings to be distinctly dwarfed and weak. About the same range of variability in root stocks was found in "free stocks," crab stocks, and paradise stocks. The latter stocks are generally considered dwarfing stocks, but both the "free" and "paradise" stocks were found to contain dwarfing and free growing stocks. "Paradise" stocks are apparently from different sources and the variety is not a true clonal variety.

In our "stock and scion" orchard we have over 400 trees of ten varieties. These trees were worked in "French Crab" and Tolman Sweet roots in 1913. An analysis of the data on this orchard shows that in circumference of trunk in 1921 the trees worked on "French Crab" stock are more variable than trees on Tolman Sweet roots. This is to be expected since "French Crab" seedlings are from numerous varieties and types of trees. The Tolman stocks are from a clonal variety and are less variable than French Crab stocks.

When the trees for the "stock and scion" orchard were taken from the nursery they varied considerably in size. If these differences in size were due to difference in the soil of the nursery we would not expect these differences to be permanent when the trees were transplanted in the orchard. The random planting of large and small trees should smooth out differences in growth if soil is the only factor involved. If, however, the variation in size of nursery trees is due to the effect of root stocks or scions then differences in size will persist in the trees when set in the orchard. The buds of each variety were selected from a single tree in each case, thus largely eliminating any possible difference in growth of scion due to bud mutation. The growth of different varieties on different stocks was not found to be the primary cause of correlation between size of nursery tree and the same tree in the orchard. We have found that the trees which are small when set in the orchard are also the small trees in succeeding years. The correla-

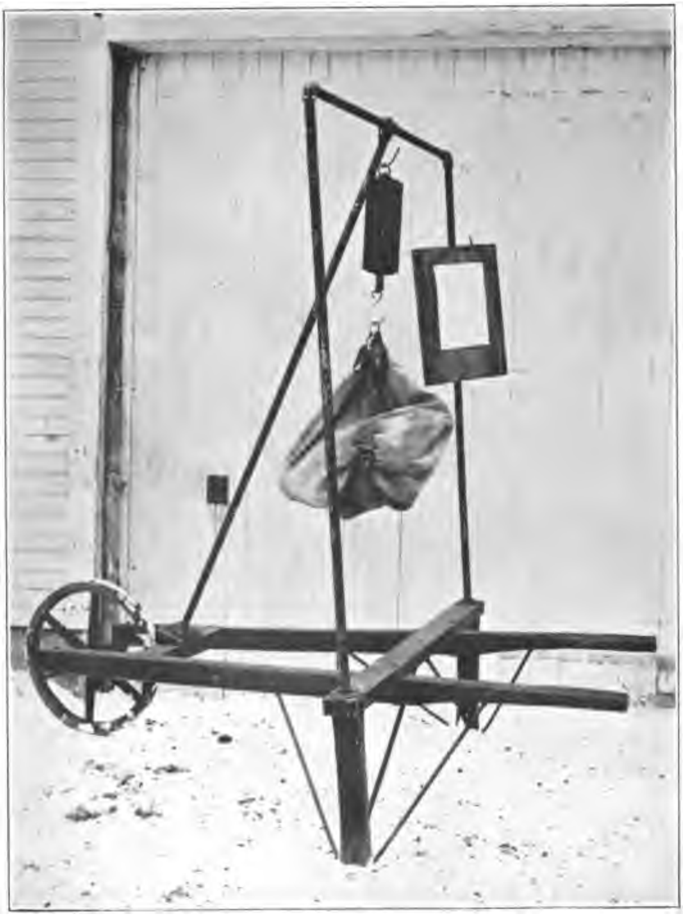

FIG. 1. Apparatus used for weighing fruit.

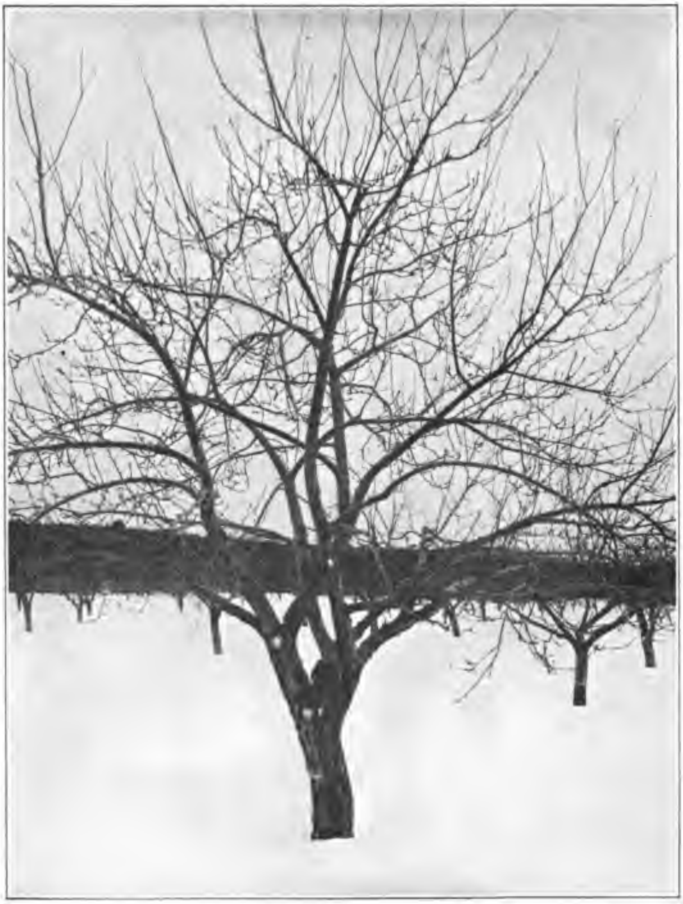

FIG. 2.

Ben Davis tree 13 Row 21. A productive "Type 1" tree.

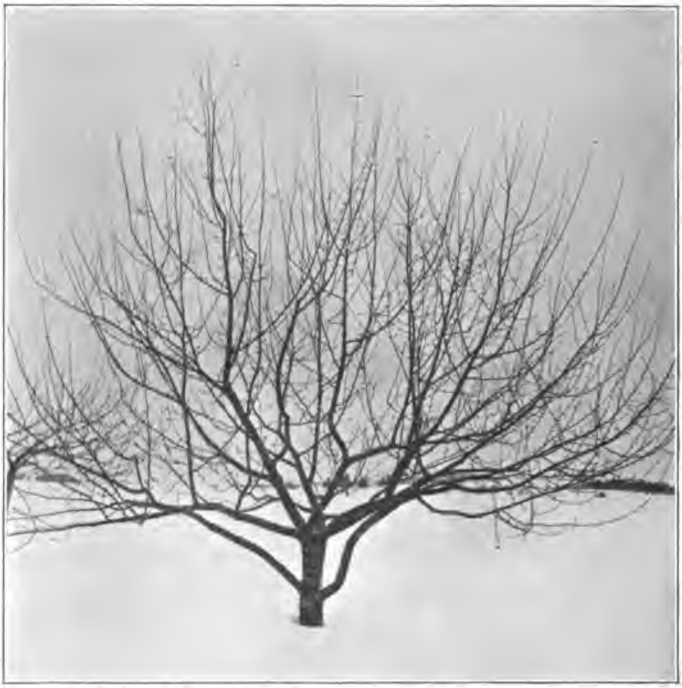

FIG. 3.

Ben Davis tree 13 Row 2. An unproductive "Type 3" tree.

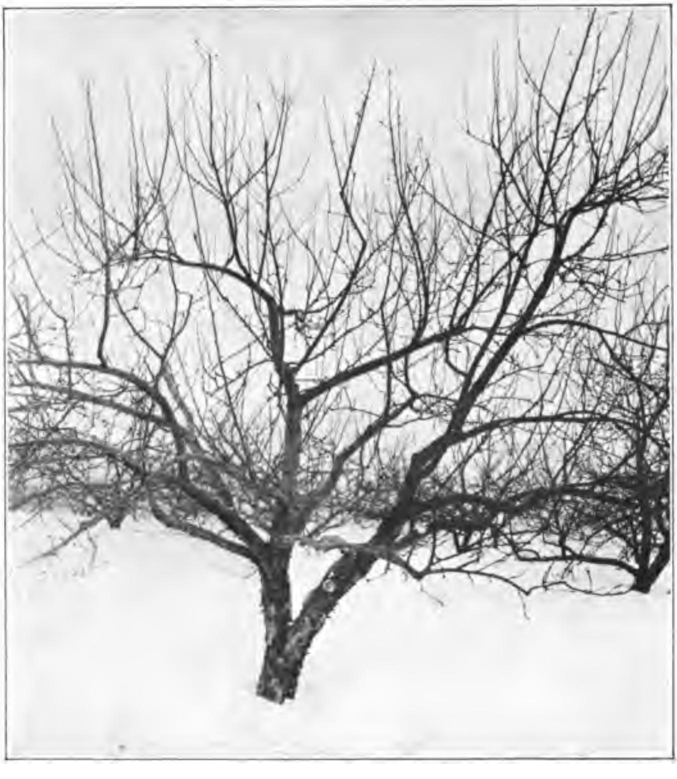

Fig. 4.

Ben Davis tree 27 Row 5. Medium productive "Type 2" tree.

tion between circumference in 1916, two years after the trees were set, and the circumference in 1921, was found to be very high. (r=.68) We may conclude then that small trees in the nursery, in general result in small trees in the orchard, due to a considerable extent to the effect of the root stock.

In citrus trees Webber (12) has found great variability of root stocks both in size and morphological characters. The variable root stocks are considered one of the primary causes of variability in nursery trees budded on such stock. Webber has shown that large, medium and small nursery trees of Washington naval and Valencia oranges and Marsh grapefruit retain, to a considerable extent, their relative sizes when grown in the orchard for several years. The growth of the different sizes of nursery trees are not given in detail and it may be questioned if the differences in size of orchard trees are significant. Webber attributes many of the irregularities in size and fruitfulness of orchard trees to the use of the seedling root-stocks for citrus trees.

Since root stocks grown from seeds are extremely variable and may often be weak and dwarfed it is not surprising that clonal varieties grafted on such stock vary greatly in growth and productivity. The presence of many unproductive trees in our Ben Davis orchard may be attributed, in part at least, to the effect of weak or incompatible root stocks.

VARIABILITY IN TREE TYPE AND PRODUCTIVITY DUE TO BUD VARIATION.

In recent years much of the variability in performance of fruit trees within a clonal variety has been attributed to bud mutation. This belief has been strengthened by the work of Shamel and his colleagues (8-11) with citrus fruit in California. As a result of Shamel's work there has been a general acceptance of the idea that bud mutation may cause increased or decreased yields not only in citrus varieties, but in other fruits as well.

In a paper, the publication of which has been somewhat delayed, we have analyzed in considerable detail the data pertaining to bud variation in citrus and apple varieties. We will therefore limit the present discussion of bud variation to the more important phases of the work with apples.

Experiments on bud variation in apples have been conducted by Whitten in Missouri, Macoun and Davis in Canada, and Cummings in Vermont. Whitten (13) selected scions from an exceptionally poor Ben Davis tree and others from the best Ben Davis tree in the orchard. There was no significant difference in the performance of the progeny of the two extreme types.

Macoun (6) selected scions from a heavy bearing, a regular bearing, and a very unproductive tree in a row of 18 Wealthy trees. A comparison of four years' yield of trees obtained by grafting with scions of the above tree types showed no significant difference in the performance of the progeny of the parental types. In actual amount of fruit, the trees resulting from the most productive parent produced slightly less fruit than either the progeny of the regular bearing or unproductive trees. The differences were in no case statistically significant.

More recently Davis (1A) has reported the performance of the above Wealthy trees covering a nine year period—1912-1920. The progeny of the productive regular bearing and unproductive trees perpetuated these characters to a great degree and the differences are statistically significant. The productive progeny were large and thrifty while the trees from the unproductive parent were small and weak and many had died during the course of the experiment. It may well be questioned whether the differences in productivity of these Wealthy trees are due to inherent genetic differences or to a transmitted disease or perhaps due to the relative vigor of the parents.

Recently Cummings (1) has reported the results of a rather extensive bud selection experiment in Vermont. Scions were selected from productive and unproductive trees of seven varieties. Two hundred and forty-eight scions were used, 120 scions from productive trees and 128 from unproductive ones. At the end of ten years 86 of the "productive" and 82 of the "unproductive" scions had borne fruit. In many cases the two classes of scions were grafted into the same variety or even the same tree. In general the scions from the productive trees were no more productive, in fact they were somewhat less productive, than scions from the unproductive trees. The difference in favor of the "unproductive" scions are probably not significant, but at least there is no indication that scions from productive trees are superior to scions from unproductive trees of a clonal variety.

In other words the difference in performance of trees of a clonal variety of apples, in the above case at least, are apparently not inherent but are the result of environmental factors—probably soil and root stocks.

THE COST OF KEEPING UNPRODUCTIVE TYPES OF TREES.

The cost of bringing an orchard to a bearing age and the cost of keeping a mature orchard in good condition is so great that the presence of many unproductive trees prevents profitable operations. We have shown that a considrable number of the trees in our Ben Davis orchard are very unproductive, due primarily to the effect of soil and unfavorable root stocks. It is possible to determine the approximate cost of growing, cultivating, and spraying a mature apple tree. With this knowledge we can determine the number of unprofitable trees in the Ben Davis orchard.

Since the Ben Davis orchard at Highmoor Farm is used for experimental purposes the cost of producing fruit is not comparable to commercial operations. We have therefore used Gardner's (2) figures on the cost of growing apples in Maine in 1914. From an analysis of 9 orchards Gardner found the cost per tree for growing, picking and hauling the apples was $1.94. A more extensive analysis of 218 New York orchards by Miller (7) shows the cost per tree to be $3.39. The New York orchards were much older and the trees bore considerable more than the Maine trees recorded. We have selected the first three orchards reported by Gardner for an estimation of orchard costs as these orchards are similar to our Ben Davis orchard.

The cost of raising the apples but not picking, packing or hauling was found to be $1.41, per tree. The average price of apples in Maine for 1900-14 was $2.03 per bbl. or 1.55 cents per pound. Deducting the cost of picking, packing and hauling the cost of production was found to be 1.3 cents per pound on the tree. The cost of fruit production per tree, 141 cents, divided by the price per pound on the tree, 1.30 cents, gives us 108.5, the number of pounds of fruit a tree must have produced to pay expenses. Trees in our Ben Davis orchard which produced less than 108 lbs. of fruit in 1914 were kept at a loss while those producing more than 108 lbs. of fruit returned a profit. This figure is of course only approximate, but it is believed to be conservative and suitable for purposes of illustration.

An examination of Table 1 shows that a large proportion of the trees in our Ben Davis orchard did not yield enough to pay expenses. Most of the unprofitable trees were of Type 3 or Type 3-2. The following table shows the number and percentage of unprofitable trees in the entire orchard and for each tree type.

TABLE 3.

Unprofitable trees in Ben Davis Orchard No. 1.

Trees	Number	Percentage
Entire orchard	257	29%
Type 3	130	96%
Type 3-2	56	68%
Type 2-3	35	35%
Type 2	31	13%
Type 2-1	6	5%
Type 1-2	0	0%
Type 1	0	0%

The relation between tree type and number of unprofitable trees is shown graphically in Figures 6 and 7. The yields of Type 1 trees are shown in Figure 5.

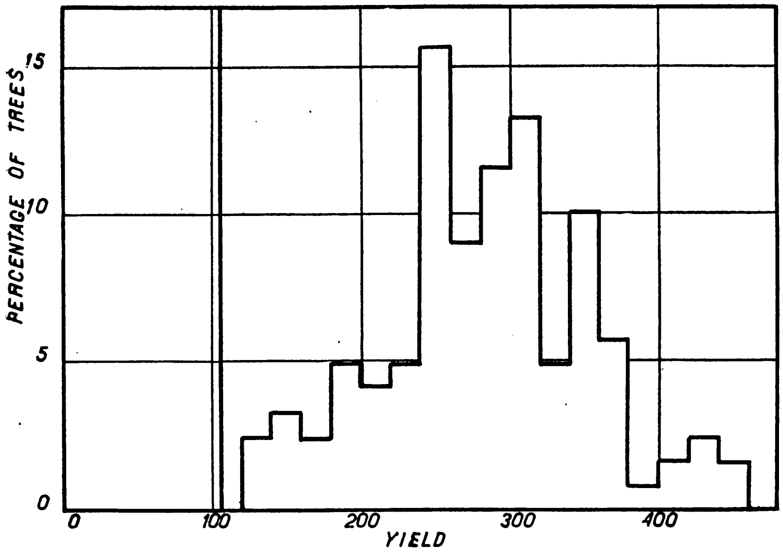

FIG. 5. Distribution of yield of Type 1 trees for 1914. All of these trees yielded more than 108 lbs. of fruit and were kept at a profit.

The yields are grouped in 20 lb. classes and the percentage of trees in each class is graphically represented. All of the Type 1 trees yielded more than 108 lbs. of fruit per tree and were kept at a profit. The average yield of the Type 1 trees for 1914 was 284 lbs. or 176 lbs. more than necessary to pay for cost of production. The average net profit of Type 1 trees was then approximately $2.30 per tree.

Figure 6 shows the yields of Type 2 trees in 1914. Only 31, or 13%, of these trees failed to pay expenses.

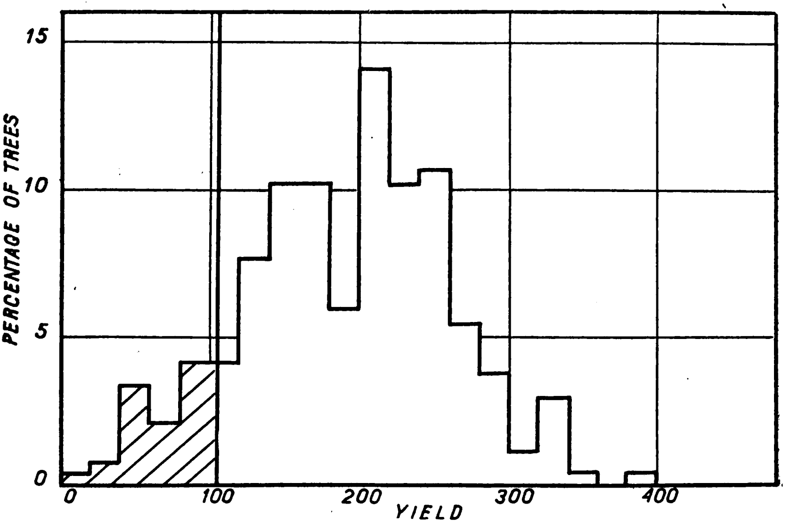

FIG. 6. Distribution of yield of Type 2 trees for 1914. The shaded area shows the number of trees which were kept at a loss. The other trees were kept at a profit.

In Figure 7 is shown the distribution of the yields of Type 3 trees. Practically all of these trees were kept at a loss. Since the Type 3 trees produced an average of only 40 lbs. of fruit in 1914 they were kept at an average loss of approximately $.90 per tree. It is evident that Type 3-2 and especially Type 3 trees were unprofitable.

ELIMINATION OF UNPRODUCTIVE TREES.

The unproductive apple trees in our Ben Davis orchard have been shown to be associated with a certain type of growth. Although no detailed records have been made casual observation indicates that tree type or habit of growth is also associated with yield in other apple varieties . The trunk girth is also a very accurate measure of an apple tree's productivity and for practical purposes may be a better index of productivity than tree type since the problem of personal judgment is eliminated. The trunk girth is also a good index of a tree's value at a very early age so that it could be used to advantage in culling nursery stock or culling undesirable trees from a young orchard not yet in bearing. If a tree makes a very poor growth for several years after it has been set in the orchard it will probably never be a desirable and profitable tree. Such trees could be replaced while the orchard was young but in an older orchard the shading of adjacent trees and competition of food makes the replacing of a mature tree a difficult problem.

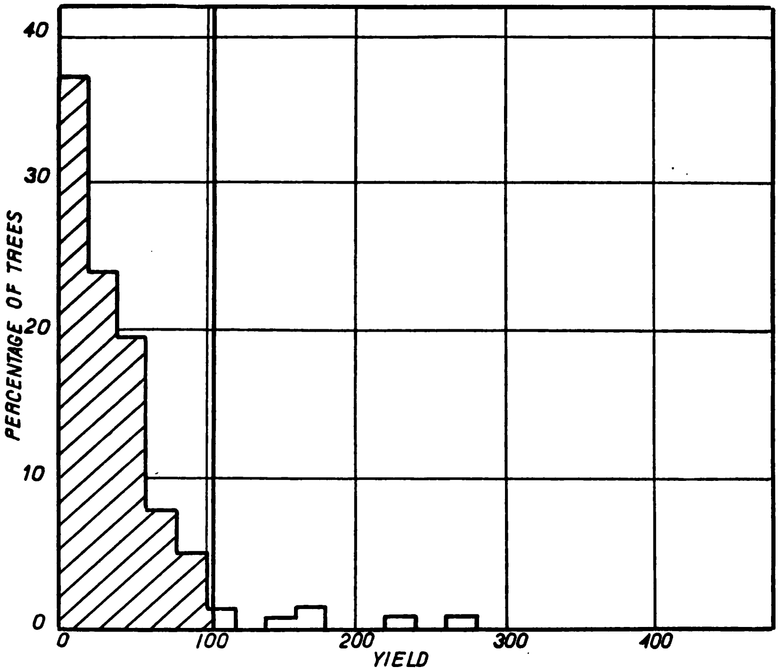

FIG. 7. Distribution of yields of Type 3 trees in 1914. Most of the trees of this type yielded less than 108 lbs. of fruit and were kept at a loss.

We have shown that the unproductive types of apple trees are due, to a considerable extent, to unfavorable nutritional conditions caused by poor soil, or by unfavorable root stocks. There is little evidence that unprductive types of trees within a clonal variety are due to inherent differences caused by bud variation.

It is possible to determine approximately the number of unproductive trees due to the effects of soil and the number of unproductive trees caused by unfavorable root stocks or factors other than soil. Where unproductive types of trees are found in groups in the orchard it is evident that soil conditions are the primary cause of these unproductive trees. Where isolated, unproductive trees are found surrounded by and sharing a common feeding ground with productive trees it is probable that root stocks are an important cause of unproductiveness. A study of the location of the unprofitable trees of inferior types shows that about 90 trees or 35% are not due to soil differences and that about 170 trees or 65% are grouped in such a manner to indicate that soil is the primary cause of unproductiveness. We have assumed that the proportion of trees found on good soil due to unfavorable root stocks or other factors also obtains on poor soil where a large percentage of inferior trees are clearly due to poor soil.

Where trees are unproductive due to poor soil the problem of bringing these trees into profitable bearing becomes one of nutrition. Fertilizer experiments on our Ben Davis orchard extending over a period of six years do not indicate that the addition of complete commercial fertilizer, even in large quantities, will influence productiveness to any great extent. So far there has been no appreciable benefit from adding a complete commercial fertilizer to our Ben Davis trees. The addition of certain nitrogenous fertilizers to Ben Davis trees or the use of fertilizer with other varieties may be of value, but if the soil is decidedly poor the necessary treatment to make it productive may not be a profitable operation. The problem becomes one of soil treatment which cannot be considered in detail in the present paper.

In a mature orchard the presence of unproductive trees due to factors other than soil presents a difficult problem. In California unproductive or otherwise undesirable citrus trees have been extensively topworked with buds from productive trees bearing fruit of a desirable type. However, what little critical evidence there is supports the belief that the top working of unprofitable apple trees is unlikely to produce returns. The severe cutting back of excessive vegetative growth of an unproductive tree for budding or grafting might possibly of itself cause it to bear heavily. Severe pruning is known to throw large, vigorous, but unproductive trees into bearing.[3] Most of our unproductive Type 3 apple trees are small and severe cutting back would probably be of no value in inducing fruitfulness.

If an unproductive tree cannot be made profitable by soil treatment or by topworking with buds or scions from productive trees the only remaining known factor of primary importance is the root stock. The unfavorable relation of the root stock cannot be easily remedied, if at all, in a mature orchard.

Unfavorable root stocks can be avoided to a considerable extent when the root stocks are budded or when the trees are set in the orchard. In citrus fruits Webber (12) has shown that small trees in the nursery are in general also small trees when grown in the orchard several years. He suggests that only large vigorous nursery trees be set in the orchard as the small nursery trees will not as a rule develop into large trees in the orchard. We have found that the small apple trees in the nursery are also small trees in the orchard in most cases. Samuel Fraser of Geneseo, N. Y. has concluded, from his extensive experience with apple trees, that small trees in the nursery result in general in small trees in the orchard. The consistent relation in size of nursery trees and the same trees in the orchard indicates that root stocks play an important part in tree growth. It is advisable then, as Webber has suggested, to select only large vigorous seedlings for budding, and to select only nursery trees which make a rapid and vigorous growth. Small stunted nursery trees should never be planted in the orchard. Such trees are not likely to be profitable at any time.

Since seedling root stocks are so variable and in some cases probably have an unfavorable influence on tree growth and productivity, it would be desirable to establish clonal varieties of root stocks. In our stock and scion orchard the trees on Tolman Sweet root stocks are more uniform in size than the trees worked on French crab stocks. These clonal varieties of Tolman Sweet root stocks were obtained by budding Tolman Sweet on French Crab and setting the scion deep enough to root. The Tolman Sweet on its own roots was then budded with the same varieties as were used on French Crab seedlings. Clonal varieties of root stocks could also be obtained by root cuttings. The use of clonal varieties of root stocks would result in more uniform and probably more productive trees.

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[3] According to Shamel (8) severe pruning of the Australian "strain" of Washington Navel orange, which is said to be less productive but larger than the Washington strain, does not result in greater production. Only two trees of the Australian "Strain" are recorded and their production is not significantly less than those of the Washington "strain."

LITERATURE CITED.

1. Cummings, M. B.
1921. Apple scion selection from high and low yeilding parent trees. *In* Vt. Agr. Exp. Sta. Bull. No. 221, p. 36-38.

1A. Davis, M. B.
1921. *In* Scientific Agriculture 2, No. 2.

2. Gardner, A. K.
1915. The cost of producing apples in Maine in 1914. Bull. of Maine Dept. of Agr. v. 14, no. 3. p. 1-22.

3. Gardner, V. R.
1920. Bud selection with special reference to the apple and strawberry, Mo. Agr. Exp. Sta. Res. Bull. No. 39, p. 3-30.

4. Harris, J. A.
1913. On the calculation of intra-class and inter-class coefficients of correlation from class moments when the number of possible combinations is large. *In* Biometrika, v. 9, p. 446-472.

5. Hatton, R. G.
1920. Suggestions for the right selection of apple stocks. *In* Jour. Roy. Hort. Soc. v. 45, p. 257-268.

6. Macoun, W. T.
1916. The apple in Canada, its cultivation and improvement. *In* Dominion Exp. Farms Bull. no. 86, p. 27-31.

7. Miller, G. H.
1920. Cost of producing apples in five counties in western New York, 1910-1915. U. S. Dept. Agr. Bull. No. 851, p. 1-47.

8. Shamel, A. D., Scott, L. B., and Pomeroy, C. S.
1918. Citrus-fruit improvement. A study of bud variation in the Washington Naval orange. U. S. Dept. Agr. Bull. 623, p. 1-146.

9. ——————
1918. Citrus-fruit improvement: A study of bud variation in the Valencia orange. U. S. Dept. Agr. Bull. 624, p. 1-120.

10. —————— and Dyer, C. L.
1920. Citrus-fruit improvement: A study of bud variation in the Lisbon lemon. U. S. Dept. Agr. Bull. 815, p. 1-70.

11. ————————
1920. Citrus-fruit improvement: A study of bud variation in the Eureka lemon. U. S. Dept. Agr. Bull. 813, p. 1-88.

12. Webber, H. J.
1920. Selection of stocks in citrus propagation. Calif. Agr. Exp. Sta. Bull. 317, p. 269-301.

13. Whitten, J. C.
1915. Bud selection for increasing yields. *In* Mo. Agr. Exp. Sta. Bull. 131, p. 479-480.

BULLETIN 306

STUDIES IN MILK SECRETION.[1]

XVII. Relation between Milk Yields and Butter-Fat Percentages of the 7-day and 365-day Tests, of Holstein-Friesian Advanced Registry Cattle.

BY MARIE S. GOWEN AND JOHN W. GOWEN.

INTRODUCTION.

During the course of their development two of our leading dairy breeds, the Jersey and the Holstein-Friesian, have made extensive use of the 7-day test. The Jersey breed has now practically discontinued the use of the 7-day record advocating the 365-day record as the only measure of the cow's worth as a milk producer. The discussion of the merits of the short time test and the long time test has recently entered a highly controversial stage even among its chief adherents, the Holstein-Friesian breeders. Few, if any, of the supporters of either camp have actively asserted that the long time test was not desirable. The contest has centered on the validity of the 7-day test as a measure of the cow's subsequent performance.

This question is intricate. It is really one phase of the larger question of the normal fluctuating variability of milk yield. In fact, it is from this angle that the authors were led into this problem, for whatever significance may be attached to this variability, a fairly comprehensive knowledge of its magnitude forms a necessary prelude to the further use of such data for genetic studies.

The validity of the 7-day test has been attacked chiefly by assertion rather than by the presentation of analyzed data. As a basis of investigation some of these statements are presented for further analysis.

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[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 149. This paper is one of a series of investigations in animal husbandry the continued prosecution of which has been made possible by a grant to the author from the Rockefeller Institute for Medical Research.

(1) The butter-fat percentage for the 7-day record is generally larger than the butter-fat percentage for the 365-day test. From this, it is argued that the 7-day record is invalid. It might equally well be argued that the 7-day test for milk yield is also invalid because its milk yield is not the same as the 365-day milk yield.

(2) The butter-fat percentage is claimed to be increased artificially through feeding, by causing the cow to lay on loose fat. This loose fat is secreted into the milk thus raising the 7-day butter-fat percentage above what it should be. The claim is also made that the 7-day test of five or six years ago is more indicative of the cow's milk producing capacity in the year test than is the 7-day test of today, because it is but recently that the trick of manipulating the butter-fat percentage by feeding has become generally known. The inference is made that the 365-day test is not equally affected by such manipulation. It is also inferred that this feeding in the 7-day test levels off the differences shown by the high and low testing cows in the records of longer duration.

(3) The argument is presented that the best quarter mile horses are seldom the best mile racers and that the best laying hens for the month are seldom the best for the year, therefore, why should the 7-day record indicate the worth of the cow for the long time test.

These three contentions present questions relating to important problems of the physiology of the dairy cow. The supporters of the 7-day test have chiefly argued for it as a matter of expediency, i. e. a preparatory school for the long test; development of the breed, that its discontinuence would be unfair to those men owning 7-day test cows or cows whose value depends largely on the 7-day tests in their pedigrees. These are not questions of physiology and, although they be none the less important to the Holstein-Friesian breeder, have no place in investigational work aimed primarily at the fundamental problems of the dairy cow.

The physiological questions indicated above lead to the more concise questions on which data will be subsequently presented.

a. Does the 365-day test predict the relative[2] milk yield, and butter-fat percentage of a subsequent 365-day lactation with sufficient accuracy to make the 365-day test of value?

b. Does the 7-day test predict the relative milk yield and butter-fat percentage of the 365-day lactation record of which it is a part with sufficient accuracy to make the 7-day test of value?

c. Does the 7-day test predict the relative milk yield and butter-fat percentage of the 365-day lactation of which it is not a part with sufficient accuracy to make the 7-day test of value?

The second and third questions do not, of course, require that the 7-day test have a milk yield or a butter-fat percentage equal to the 365-day test. They only require that the position occupied by the cow among the blue book cows in her 7-day test shall be closely similar to the position occupied by this same cow in her year test. On this ground the fact that the 7-day test butter-fat percentage is higher than the year test butter-fat percentage has little weight for like the 7-day milk yield some knowledge must be had of what the conversion factors should be, before either test can predict, even approximately, the subsequent year record. Similar reasoning holds for the 365-day record of one lactation in comparison with that of another lactation. This brings up the next question.

d. Is it possible to determine for milk yield and butter-fat percentage the proper correction to be applied to the 7-day test to give a reasonable value to be expected in the 365-day test?

The assertion that the dependability of the seven day test in predicting the long time test has changed during the last few years, makes the analysis of this question desirable.

MATERIALS AND METHODS

The Holstein-Friesian Advanced Registry[3] data used in this investigation were collected in connection with other studies. It is believed to include all the 365-day test and retest cows in the blue books up to number 31. It does not include all the records of cows tested for seven days and subsequently tested for 365 days. The data collected should be a good random sample of these 7-day cows which were subsequently tested for the 365-day period.

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[2] The word *relative* is inserted here because, as is well known, the milk yields of cows change with age. The cow will not be expected to have the same number of pounds of milk in one lactation as in another but will rather be expected to maintain a milk yield such that she retain her relative position among her sister cows in the subsequent milk yields that she had in the previous semi-official test.

[3] Holstein-Friesian Association of America. 1907-20. Advanced Registry Year Books. V. 18-30.

The methods employed were those in customary use where large quantities of numerical data are analyzed.

The calculation of the data to determine the relative value of the 7-day and 365-day test as an indicator of the cow's possibilities as a milker have been done for the separate age groups. This is made necessary because of the well known fact that milk yield changes with age. Under such conditions the increase of milk yield with age for the 7-day and 365-day of the same lactation will in and of itself increase the correlation coefficient should these data be lumped, especially should such lumping include the early ages. By similar reasoning the correlation coefficients for the 7-day test with the 365-day test and the 365-day test with the 365-day test at different lactations will be lowered if all data, irrespective of the cows' ages are lumped together.

The problems will be analyzed in separate parts, one for each variable. The first will deal with milk yield and the second with butter-fat percentage.

PART I. RELATION BETWEEN THE 7-DAY AND THE 365-DAY MILK YIELD

The arrangement of the different tables will be in the order given in the introduction. The whole number of 365-day records for test and retest cows is divided into separate age groups to reduce, in so far as possible, the effect of age on milk yield. The means, standard deviations and coefficients of variation for the 365-day records with the 365-day records are given in Table 1.

The reader will remember that Holstein-Friesian[4] milk yield has been shown to increase at an ever declining rate until it reaches the maximum at 8 years and 5 months. From this point

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[4] Gowen, John W. Studies in Milk Secretion VIII. On the influence of age on milk yield and butter-fat percentage as determined from the 365 day records of Holstein-Friesian cattle. In Annual Report of the Maine Agricultural Experiment Station for 1920. Bulletin 293. pp. 185-196.

TABLE 1.

Physical Constants for the Variation of 365-Day Milk Yield in Test and Retest Cows

Age Test Retest	Mean First Test	Standard Deviation First Test	Coefficients of Variation First Test
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	14,033±266	2647±188	18.9±1.4
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	12,935±301	3026±213	23.4±1.7
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	13,221±294	2856±208	21.6±1.7
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	15,167±600	3771±424	24.9±3.0
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	16,722±422	3757±299	22.5±1.8
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	16,523±375	3650±265	22.1±1.7
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	19,157±382	4726±269	24.7±1.5

Age Test Retest	Mean Retest	Standard Deviation Retest	Coefficients of Variation Retest
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	16,567±441	4389±312	26.5±2.0
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	17,652±421	4237±298	24.0±1.8
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	20,081±437	4244±309	21.1±1.6
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	17,000±621	3905±439	23.0±2.7
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	20,722±553	4922±391	23.8±2.0
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	19,733±433	4209±306	21.3±1.6
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	20,586±356	4417±252	21.5±1.2

the milk yield declines slightly as age advances. Since the age effect is greatest between the years 1 year and 9 months to five years, the attempt was made to make as many age divisions, during this time, as the data would allow. At the older age, where the age effect is less, the divisions are made broader.

The mean milk yields for the first tests at the different ages, as given in Table 1, are quite variable. Their average has a reasonable agreement with the milk yields for the whole breed as given in a previous paper.[5] This agreement would indicate that no selection of high milking cows for subsequent retest had been made.

If the mean milk yields of the retest cows are compared with the mean milk yield of the first test cows, the same ages being included in each group, it is found that the retest cows exceed the first test cows in milk yield. The excess milk yield for each age group is scarcely significant. Taken for all groups, where the data are weighted as the square root of n, the average difference between the test and retest milk yields is 833 pounds. This difference is probably significant.

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[5] Loc. cit.

A similar difference between test and retest cows has been shown to exist in the Guernsey breed.[6] The effect of the first test is much more pronounced in the Guernsey than it is on these Holstein-Friesian cows.

Table 2 presents similar information for the milk yields of the Holstein-Friesian cows with 7-day and 365-day tests where the 7-day test is a part of the 365-day test.

If the average 7-day milk yields of Table 2 are compared with the average 7-day milk yields of all Holstein-Friesian[7] cows, recorded up to volume 25, of the advanced register, it is found that the 7-day test cows tested for 365-day records produce about 50 pounds of milk more than all the advanced registry cows. The mean milk yield of the 365-day tests for the different age groups is, on the whole, lower than the mean milk yield found for these age groups including all animals with 365-day tests recorded in the advanced registry up to volume 31. Individually considered these differences are not significant in comparison with their probable errors. The consistancy of the difference probably indicates that the 365-day records are slightly lower in milk yield. This is in line with what will be shown in a subsequent paper,—that there is a slightly significant increase of milk yield from dam to daughter in this breed. The cause of this increase is not known for it is a question whether it is due to better feeding and handling or to an actual accumulation of better hereditary factors for milk yield in the daughters of today in comparison with the dams of yesterday ascribable to a better perception of the laws of heredity underlying breeding operations.

The coefficients of variation give the comparative values of the variations of the 7-day and 365-day tests. The 7-day tests are proportionately less variable than the 365-day tests. The conclusion to be drawn from this fact is not sharply defined. It may be argued that since the 7-day test is less variable than the 365-day test it is a better measure of the cow's worth, or again

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[6] Gowen, John W. Studies in Milk Secretion X. The relation between the milk yield of one lactation and the milk yield of a subsequent lactation in Guernsey Advanced Registry Cattle. In press.

[7] Miner, John R. 1915. Fitting Logarithmic Curves by the Method of Moments. In Jour. Agri. Research, Vol. III, No. 5, pp. 411-423. Data in Table 1.

TABLE 2.

Physical Constants for the Variation of 7-Day and 365-Day Milk Yield Where the 7-Day Test is a Part of the 365-Day Test

Age	Mean 7-day Milk Yield	Standard Deviation 7-day Milk Yield	Coefficients of Variation 7-day Milk Yield
1 year 6 months and 2 years 0 months	304±4	48±3	15.8±1.1
2 years 0 months and 2 years 6 months	353±2	67±2	19.1±.5
2 years 6 months and 3 years 0 months	371±3	68±2	18.3±.6
3 years 0 months and 3 years 6 months	381±5	82±4	21.6±1.0
3 years 6 months and 4 years 0 months	430±5	76±3	17.8±.8
4 years 0 months and 4 years 6 months	465±6	79±4	17.0±.9
4 years 6 months and 5 years 0 months	467±6	83±5	17.8±1.0
5 years 0 months and 5 years 6 months	494±7	84±5	16.9±1.0
5 years 6 months and 6 years 0 months	508±7	87±5	17.2±.9
6 years 0 months and 6 years 6 months	495±7	71±5	14.3±1.0
6 years 6 months and 7 years 0 months	513±9	91±6	17.8±1.3
7 years 0 months and 7 years 6 months	503±9	80±6	16.0±1.2
7 years 6 months and 8 years 0 months	516±13	92±9	17.8±1.8
8 years 0 months and 8 years 6 months	542±15	91±10	16.9±2.0
8 years 6 months and 9 years 0 months	510±13	80±9	15.7±1.9
9 years 0 months and 9 years 6 months	485±10	55±7	11.4±1.4
9 years 6 months and 11 years 0 months	516±14	83±10	16.0±1.9
11 years 0 months and 15 years 0 months	508±19	69±13	13.5±2.8

Age	Mean 365-day Milk Yield	Standard Deviation 365-day Milk Yield	Coefficients of Variation 365-day Milk Yield
1 year 6 months and 2 years 0 months	11811±239	2585±169	21.9±1.5
2 years 0 months and 2 years 6 months	13548±100	2776±70	20.5±.5
2 years 6 months and 3 years 0 months	14160±134	2817±95	19.9±.7
3 years 0 months and 3 years 6 months	14667±173	2702±122	18.4±.8
3 years 6 months and 4 years 0 months	15333±189	3109±134	20.3±.9
4 years 0 months and 4 years 6 months	15901±289	3861±205	24.3±1.3
4 years 6 months and 5 years 0 months	17402±252	3272±178	18.8±1.1
5 years 0 months and 5 years 6 months	17694±318	3995±225	22.6±1.4
5 years 6 months and 6 years 0 months	17625±291	3861±206	21.9±1.2
6 years 0 months and 6 years 6 months	18157±299	3165±211	17.4±1.2
6 years 6 months and 7 years 0 months	18653±378	3926±267	21.0±1.5
7 years 0 months and 7 years 6 months	18450±368	3449±260	18.7±1.5
7 years 6 months and 8 years 0 months	19043±631	4486±446	23.6±2.5
8 years 0 months and 8 years 6 months	18111±480	3016±339	16.7±2.0
8 years 6 months and 9 years 0 months	17647±492	3009±348	17.0±2.0
9 years 0 months and 9 years 6 months	18400±290	1665±205	9.1±1.1
9 years 6 months and 11 years 0 months	16471±640	3913±453	23.8±2.9
11 years 0 months and 15 years 0 months	17667±1571	5706±1111	32.3±6.8

the argument may be that the 365-day test is more variable than the 7-day test because it tests out the producing capacities of all cows more thoroughly. The choice of either horn of this dilemma does not help much toward the true statement of the facts desired; i. e. the real worth of the two tests.

Table 3 gives the mean milk yields, the standard deviations and the coefficients of variation of the 7-day and 365-day test for those 7-day test cows which had another lactation record of 365 days at a different age.

TABLE 3.

Physical Constants for the Variation of the 7-Day and 365-Day Milk Yield Where the 7-Day Record is Made in a Separate Lactation from the 365-Day Milk Yield

Age 7-day Test and 365-day Test	Mean 7-day Milk Yield	Standard Deviation 7-day Milk Yield	Coefficients of Variation 7-day Milk Yield
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	341±5	61±4	17.9±1.1
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	325±6	55±4	16.9±1.4
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	329±8	64±6	19.4±1.8
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	305±6	50±4	16.4±1.3
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	401±8	75±6	18.7±1.5
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	437±12	90±9	20.5±2.1
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	364±11	72±8	19.7±2.3
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	430±7	57±5	13.3±1.2
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	452±15	115±11	25.5±2.6
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	465±10	85±7	18.3±1.6

Age 7-day Test and 365-day Test	Mean 365-day Milk Yield	Standard Deviation 365-day Milk Yield	Coefficients of Variation 365-day Milk Yield
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	15869±335	3881±237	24.5±1.5
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	15895±321	2936±227	18.5±1.4
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	17630±464	3571±328	20.3±1.9
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	17784±437	3940±309	22.2±1.8
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	16103±359	3327±254	20.7±1.7
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	18480±621	4605±439	24.9±2.5
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	18211±539	3488±382	19.2±2.2
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	17071±439	3443±310	20.2±1.9
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	18077±461	3485±326	19.3±1.8
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	18200±510	4142±361	22.8±2.1

The facts shown in Table 3 are essentially the same as those shown in the preceding tables. Our problem deals largely with the relative values of the 7-day test and the 365-day test as a measure of a cow's worth. The correlation coefficients to determine these relationships are given in the Table 4.

RELATIVE MERITS OF THE 7-DAY AND 365-DAY TESTS FOR MILK YIELD AS INDICATING THE COW'S PRODUCING CAPACITY.

TABLE 4.

Correlation Coefficients for the Variables 365-Day Milk Yield and 365-Day Milk Yield for Different Lactations, 7-Day Milk Yield and 365-Day Milk Yield for the Same Lactation, 7-Day Milk Yield and 365-Day Milk Yield for Different Lactations

365-day Milk Yield and 365-day Milk Yield Different Lactations. Age Test Retest	Correlation Coefficient
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	.733±.047
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.705±.050
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	.480±.079
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.777±.062
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	.702±.057
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	.584±.068
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	.689±.042
Mean	.667
Weighted Mean	.660

7-day Milk Yield and 365-day Milk Yield Same Lactation. Age	Correlation Coefficient
1 yr. 6 mo. and 2 yrs. 0 mo.	.653±.053
2 yrs. 0 mo. and 2 yrs. 6 mo.	.679±.019
2 yrs. 6 mo. and 3 yrs. 0 mo.	.624±.029
3 yrs. 0 mo. and 3 yrs. 6 mo.	.355±.056
3 yrs. 6 mo. and 4 yrs. 0 mo.	.623±.037
4 yrs. 0 mo. and 4 yrs. 6 mo.	.732±.035
4 yrs. 6 mo. and 5 yrs. 0 mo.	.447±.062
5 yrs. 0 mo. and 5 yrs. 6 mo.	.584±.052
5 yrs. 6 mo. and 6 yrs. 0 mo.	.574±.050
6 yrs. 0 mo. and 6 yrs. 6 mo.	.634±.056
6 yrs. 6 mo. and 7 yrs. 0 mo.	.587±.063
7 yrs. 0 mo. and 7 yrs. 6 mo.	.477±.082
7 yrs. 6 mo. and 8 yrs. 0 mo.	.794±.052
8 yrs. 0 mo. and 8 yrs. 6 mo.	.518±.116
8 yrs. 6 mo. and 9 yrs. 0 mo.	.521±.119
9 yrs. 0 mo. and 9 yrs. 6 mo.	—.115±.172
9 yrs., 6 mo. and 11 yrs. 0 mo.	.740±.074
11 yrs. 0 mo. and 15 yrs. 0 mo.	.835±.083
Mean	.583
Weighted Mean	.598

7-day Milk Yield and 365-day Milk Yield Different Lactations. Age	Correlation Coefficient
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	.451±.069
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.521±.080
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	.592±.084
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	.321±.099
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.318±.097
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	.441±.109
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	.555±.107
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	.478±.098
4 yrs. to 5 yrs. and 6 yrs to 10 yrs.	.636±.079
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	.441±.099
Mean	.475
Weighted Mean	.462

The correlation coefficients for the milk yield of the 365-day test with the milk yield of a subsequent 365-day lactation are all rather high for data dealing with milk yield. The average correlation coefficient for this relation is 0.667. The relation between the 7-day milk yield and the 365-day milk yield where the 7-day milk yield is in the lactation of the 365-day milk yield is less than the relation between the milk yields of two 365-day lactations. The relation between the milk yield of the 7-day test and the milk yield of the 365-day test where the 7-day test is in a separate lactation from the 365-day test is less than either of the two preceding correlations. From these considerations it follows that the 365-day test is a better indicator of a subsequent 365-day lactation's milk yield than is the 7-day test. The 7-day milk yield is a better indicator of the milk yield of a 365-day lactation of which it is a part than the 7-day milk yield is an indicator of the 365-day milk yield of another lactation. All of the correlation coefficients are high in comparison with those found heretofore for most economic quantitative characters. Such being the case it is well to consider any test for milk yield, however short it may be, in selecting dairy cows.

LINEARITY OF REGRESSION

The nature of the regression lines for the tables presented above is important. The correlation ratios and the tests for the linearity of the regression, correlation ratio squared minus the correlation coefficient squared, are given in Table 5.

TABLE 5.

Data for the Test of the Linearity of Regression for the Tables Whose Correlation Coefficients are presented in Table 4

365-day Milk Yield and 365-day Milk Yield Different Lactations. Age	Correlation Ratios	η^2-r^2
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	.837	.162±.074
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.780	.112±.063
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	.784	.385±.100
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.919	.240±.136
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	.890	.299±.103
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	.769	.250±.089
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	.790	.148±.057
Average.	.824	

7-day Milk Yield and 365-day Milk Yield Same Lactation. Age	Correlation Ratios	η^2-r^2
1 yr. 6 mo. and 2 yrs. 0 mo.	.799	.213±.076
2 yrs. 0 mo. and 2 yrs. 6 mo.	.684	.007±.006
2 yrs. 6 mo. and 3 yrs. 0 mo.	.668	.057±.022
3 yrs. 0 mo. and 3 yrs. 6 mo.	.529	.538±.046
3 yrs. 6 mo. and 4 yrs. 0 mo.	.663	.051±.027
4 yrs. 0 mo. and 4 yrs. 6 mo.	.759	.040±.029
4 yrs. 6 mo. and 5 yrs. 0 mo.	.524	.075±.040
5 yrs. 0 mo. and 5 yrs. 6 mo.	.664	.101±.048
5 yrs. 6 mo. and 6 yrs. 0 mo.	.658	.103±.046
6 yrs. 0 mo. and 6 yrs. 6 mo.	.676	.054±.043
6 yrs. 6 mo. and 7 yrs. 0 mo.	.704	.151±.069
7 yrs. 0 mo. and 7 yrs. 6 mo.	.541	.065±.053
7 yrs. 6 mo. and 8 yrs. 0 mo.	.812	.030±.048
8 yrs. 0 mo. and 8 yrs. 6 mo.	.735	.273±.142
8 yrs. 6 mo. and 9 yrs. 0 mo.	.570	.054±.074
9 yrs. 0 mo. and 9 yrs. 6 mo.	.819	.657±.165
9 yrs. 6 mo. and 11 yrs. 0 mo.	.847	.169±.122
11 yrs. 0 mo. and 15 yrs. 0 mo.	.972	.246±.237
Average	.701	

7-day Milk Yield and 365-day Milk Yield Different Lactations. Age	Correlation Ratios	η^2-r^2
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	.596	.152±.062
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.561	.043±.044
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	.669	.097±.077
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	.388	.047±.047
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.455	.106±.067
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	.527	.084±.075
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	.785	.307±.143
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	.738	.315±.118
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	.666	.039±.052
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	.587	.150±.088
Average	.597	

The correlation ratios, shown in Table 5, are all high in value. The year test milk yield has the highest average value in predicting the subsequent 365-day test milk yield. Of the 7-day tests, the test within the 365-day lactation predicts the year milk yield better than the 7-day test of another lactation.

The relation between the correlation ratios and the correlation coefficient shows that the regressions are probably all linear.

RELATIONS SHOWN BETWEEN ECONOMIC CHARACTERS

It is desirable to have some comparative data to assist in the proper evaluation of the 7-day and 365-day test of Holstein-Friesian cattle as given above. Table 6 gives these for certain of our economic characters.

If a comparison is made between the 365-day tests of Guernsey and Holstein-Friesian cows, the reliability of these tests in predicting a subsequent 365-day retest is found to be practically the same. The average correlation for the Guernseys is .696 and for the Holstein-Friesian is .667. It takes but a glance at the rest of the table to show that these correlation coefficients are high. These tests are quite reliable in predicting the subsequent yield.

The advanced registry records appear to be more dependable than records taken for a whole herd as the correlation coefficients for the Jersey herd records are lower by about .1 than the advanced registry records. This may be due to the better preparation given to cows put on advanced registry test.

TABLE 6.

Correlation Coefficients Between Characters of Economic Importance

Character	Breed	Correlation	Authority
Milk yield and milk yield	Guernsey Advanced Registry	.462 to .811	Gowen[1]
Milk yield and milk yield	Jersey pure-bred herd	.214 to .731	Gowen[2]
Milk yield and milk yield (revised maximum)	British Holsteins and Shorthorns	.394 to .762	Gavin[3]
365-day yield and 365-day milk yield	Holstein-Friesian	.480 to .777	This paper
7-day milk yield and 365-day milk yield (same lactation)	Holstein-Friesian	—.115 to .835	This paper
7-day milk yield and 365-day milk yield (different lactation)	Holstein-Friesian	.318 to .636	This paper
Wool clip of one season and wool clip of another season	Ranbouillet	.51	Hill[4]
Lobe color and yearly egg production	White Leghorn	—.527 to —.582	Harris, Blakeslee and Warner[5]
Monthly egg yield and other 11 months' production	White Leghorn	.240 to .573	Harris and Blakeslee[6]
Milk yield and Score (Conformation)	Jersey Registry of Merit	—.070 to +.194	Gowen[7]

[1] Gowen, John W. 1921. The Relation between the Milk Yield of one lactation with the milk yield of a subsequent Lactation in Guernsey Advanced Registry Cattle. In press.

[2] Gowen, John W. 1920. Studies in Milk Secretion V. On the Variations and Correlations of Milk Secretion with Age. Genetics, Vol. 5, p. 111-188.

[3] Gavin, William. 1913. Studies in milk records on the accuracy of estimating a cow's milking capacity by her first lactation yield. Jour. Agric. Soc. Vol. 5, pp. 377-391.

[4] Hill, J. A. 1921. Studies in the Variation and Correlation of Fleeces from Range Sheep. Bulletin No. 127. Wyoming Agricultural Experiment Station, pp. 39-52.

[5] Harris, J. Arthur, Blakeslee, A. F., and Warner, D. E. 1917. The correlation between body pigmentation and egg production in the domestic fowl. Genetics 2, p. 36-81.

[6] Harris, J. Arthur, and Blakeslee, A. F. 1918. The correlation between egg production during various periods of the year in the domestic fowl. Genetics 3, p. 27-73.

[7] Gowen, John W. 1920. Conformation and its Relation to Milk Producing Capacity in Jersey Cattle. Jour. Dairy Science, Vol. III, No. 1, p. 1-32.

The next highest coefficients are those found for the 7-day test in relation to the year tests. These coefficients are also high. The reliability of the 7-day test is not quite as great as that for the year test. The 7-day test has a much greater value for predicting the year test than has any point of conformtion, in fact the 7-day test is nearly 2½ times as good an indicator of year milk yield as any of the conformation points are of year milk yield.

The comparison between the wool clip of one season as an indicator of the wool clip of subsequent seasons and a milk yield (7 or 365 days) as an indicator of a subsequent milk yield shows that the milk yield predicts the milk yield of a subsequent lactation slightly better than the amount of wool in the fleece of one season predicts the amount of wool in the fleece for other seasons.

It is of interest to note that the lobe color in White Leghorn pullets has about the same value in predicting what egg production may be expected from a bird,—as a milk record has in predicting the milk record of a subsequent lactation.

As noted in the introduction of this paper, the assertion was made that the best laying hens for a month are seldom the best laying hens for the year. It is interesting to view the evidence as presented in Table 6 for the white leghorn hens. While the correlations are not very large they show clearly that the egg production of a month does indicate what the egg production of the year will be. In fact the better the layer for the month the more chance it has to be good for the year. In fact were this not so, there would be little basis for culling chickens for the points used in culling are essentially those which indicate that the hens are laying at the time of culling. As Table 6 shows, the value of a milk record, either of 7-days or of 365-days duration, is greater as an indicator of the milk yield of a subsequent lactation record than the value of a monthly egg record is as an indicator of the year's production. Such being the case it does not seem justifiable to discard the 7-day test for the 365-day test when support is given to the monthly egg record as an indicator of the yearly production.

The authors know of no adequate analysis of any statistics on the relation of speed in trotting, running or pacing horses over the quarter mile and mile courses. In view of this lack of knowledge it would not be desirable to make the assertion that fast mile horses would probably be well up in the fast class of the quarter mile horses although from general experience with data of this kind it would seem as if such an assertion could be justified by subsequent analysis of data on trotting records.

EFFECT OF GROUPING ALL MILK RECORDS TOGETHER IN DETERMINING THE RELATION OF THE 7-DAY AND 365-DAY LACTATION RECORDS

The investigation of the effect of grouping all records together in determining the relation of the 7-day and 365-day lactation records is of interest as it throws some light on another's research on this problem. In his study, Mr. Yapp[8] showed that the correlation coefficient for the semi-official and 7-day milk yields all lumped together is approximately +0.7. From this the conclusion is drawn that, "the correlation .702 is for certain purposes a high degree of correlation, but it is not a high degree of correlation between two measurements of the same thing." Continuing he says "it further follows that since the correlation between seven day and semi-official test is not high, it is not safe to attempt to use the seven day as a criterion by which to judge semi-official production." The point of this quotation all hinges on what correlation may be considered high for milk yield, etc., in dairy cattle and on the definition of "measurements of the same thing." By "measurements of the same thing" Mr. Yapp appears to mean the 365-day test. It seems to the authors, however, that what both measurements are aiming at is the total milk yield, etc., of the cow through her life time. If the authors' view is held, inquiry must be made into how accurately the 365-day test measures the cow's capacities as a producer of milk. In fact on either view such a comparison seems desirable.

If the data as analyzed in separate age groups for the correltion coefficients given in Table 4 are lumped together the correlation coefficients are obtained as shown in Table 7.

TABLE 7.

Correlation Coefficients Between 7-Day and 365-Day Milk Yields, the Age of Cow Disregarded

Characters Correlated	Correlation Coefficient
365-day milk yield and 365-day milk yield	.635±.023
7-day milk yield and 365-day milk yield (same lactation)	.749±.008
7-day milk yield and 365-day milk yield (different lactation)	.852±.027

The comparison is more favorable to the 7-day test within the lactation as a means of predicting that lactation's yield than it is to the 365-day test. It will be noted that this makes the conclusion of Mr. Yapp questionable. However, if the data are calculated for the separate age groups, as shown in Table 4, it is seen that the truth of the matter is that the 365-day test is slightly better than the 7-day test as an indicator of milk yield. The difference in the results of these two tables is that the 7-day test correlation was increased artificially and the 365-day test correlation was decreased by lumping all records. It follows from this that the conclusions based on Table 4 are more likely to be correct than are conclusions based on the method, used by Mr. Yapp, of lumping records irrespective of age.

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[8] Yapp, W. W. 1919. A study of the relative reliability of official tests of dairy cattle. In Bul. 215. Illinois Agr. Expt. Sta. pp. 323-329.

The lumping of all data for the 7-day test and the 365-day test for different lactations has reduced the true correlation considerably due to the influence of age on milk yield. The true worth of the 7-day test as an indicator of a year milk yield in another lactation is considerably greater than the figure shown in Table 7 as may be seen from an examination of Table 4.

CHANGES IN THE VALUE OF THE 7-DAY TEST AS AN INDICATOR OF THE YEAR TEST DURING THE PAST YEARS

As noted in the introduction, the claim has been made that in recent years the dairymen have been able, by proper feeding, to influence the 7-day test record so that it gives a false picture of the cow's true worth as a producer. This method of manipulating the feed is said to have come to light only in the past few years. From this it is asserted that the 7-day test today is less reliable than the 7-day test of some years ago in predicting the year test record. This assertion may be subjected to analysis to determine what grounds exist for it. The crucial evidence for or against this hypothesis comes in a comparison of the correlation coefficients for the 7-day and 365-day records for a group of cows tested early in the history of advanced registry testing and another group tested just recently. The data used for this point were the 2-year old and the 6- to 9-year old records of cows tested for 7- and 365-days in the same lactation. Such a division gives a group of young cows and a group of mature cows for comparison. The data on each group were split into approximately two equal parts. The first group for the 2-year olds contained herd book numbers from 66417 to 159419 and the second group's numbers were from 159486 to 211236. The groups for the 6- to 9-year old cows were 49440 to 95253 and 95273 to

158760. The correlations and their comparisons are given in Table 8.

TABLE 8.

Correlation Coefficients for 7-Day and 365-Day Milk Yields, Grouped to Determine the Relation Between Tests Made Recently and Tests Made Early in the Breed's History in Predicting 365-Day Milk Yield

Characters Correlated	Correlation Coefficient	Difference
Cows 2 years old		
Herd book nos. 66417 to 159419	.687±.023	
Herd book nos. 159486 to 211236	.506±.080	.181±.088
Cows 6 to 9 years old		
Herd book nos. 49440 to 95253	.572±.039	
Herd book nos. 95273 to 158760	.562±.040	.010±.053

The 2-year old cows show that the 7-day test was a slightly more reliable indicator of 365-day milk yield during the time it was first applied than it is today. The difference is small, amounting to only 3.4 times its probable error. The reliability of the 7-day test for the two groups of aged cows is the same, the difference being only an insignificant part of the probable error. If these differences are averaged it is clear that there has been no significant change in the value of the 7-day test in predicting the 365-day test within the duration of time covered by the data included in this paper. In view of this fact the assertion that the value of the 7-day test as an indicator of the 365-day test had become less in recent years, is untrue so far as these data are concerned.

PREDICTION EQUATIONS TO DETERMINE THE PROBABLE 365-DAY LACTATION YIELD FROM THE 7-DAY OR 365-DAY RECORDS

One of the chief criticisms of the 7-day test appears to come from the fact that the prediction equations to determine the probable 365-day test from the 7-day test are not known. Thus, the dairyman in viewing a record of 500 pounds of milk for the 7-day test forms but a hazy idea of what the probable milk yield of the 365-day test will be when this test is applied to the same cow.

From the data and constants given in the earlier sections of this paper it is possible to determine what the most probable 365-day record will be from either of the 7-day tests. Also the most probable record of the 365-day lactation retest may be found from the 365-day test record. These prediction equations are given below. Attention is called to the fact that the numbers of cows available for this comparison were relatively few. This is especially true for the ages three years to four years and four years to five years. The prediction of any milk yield from these equations, under these circumstances, will not be as accurate as if it were possible to base the equations on larger numbers.

365-day expected milk yield at given age   365-day test at given age

Milk yield 1 yr. 9 mo. to 3 yrs.=6706+.442 milk yield 3 yrs. to 4 yrs.
Milk yield 2 yrs. to 3 yrs.=4045+.504 milk yield 4 yrs. to 5 yrs.
Milk yield 2 yrs. to 3 yrs.=6538+.333 milk yield 5 yrs. to 8 yrs.
Milk yield 3 yrs. to 4 yrs.=2409+.750 milk yield 4 yrs. to 5 yrs.
Milk yield 3 yrs. to 4 yrs.=5622+.536 milk yield 5 yrs. to 8 yrs.
Milk yield 4 yrs. to 5 yrs.=6529+.506 milk yield 5 yrs. to 11 yrs.
Milk yield 5 yrs. to 11 yrs.=3975+.738 milk yield 6 yrs. to 13 yrs.

365-day expected milk yield retest at given age   365-day test at given age

Milk yield 3 yrs. to 4 yrs.=—503+1.216 milk yield 1 yr. 9 mo. to 3 yrs.
Milk yield 4 yrs. to 5 yrs.=4882+.987 milk yield 2 yrs. to 3 yrs.
Milk yield 5 yrs. to 8 yrs.=10656+.713 milk yield 2 yrs. to 3 yrs.
Milk yield 4 yrs. to 5 yrs.=4796+.805 milk yield 3 yrs. to 4 yrs.
Milk yield 5 yrs. to 8 yrs.=5349+.919 milk yield 3 yrs. to 4 yrs.
Milk yield 5 yrs. to 11 yrs.=8608+.673 milk yield 4 yrs. to 5 yrs.
Milk yield 6 yrs. to 13 yrs.=8249+.644 milk yield 5 yrs. to 11 yrs.

The case of a two-year-old cow giving 15000 pounds of milk may be taken to illustrate the use of these equations. Suppose the expected milk yield at 4 years to 5 years old is desired. The equation necessary to make this prediction, obtained from the above, is

Milk yield 4 yrs. to 5 yrs.=4882+.987 milk yield 2 yrs. to 3 yrs. multiplying the 2-year-milk yield 15000 by .987 we have 14805+4882=18687 the expected yield at 4 to 5 years. In a similar manner the expected milk yield of other periods may be found from one or the other of the equations given above.

It would be of some interest to have a general prediction equation when the age factor would come in as a part of the equation and not as a choice of different equations. Such an equation is complicated by the logarithmic nature of milk yield and the parabolic or logarithmic nature of the standard deviation curve. It has the advantage that in its calculation the average correlation coefficient could be used, thus striking an average as to the degree of reliability of a test. The calculation of the necessary constants would entail a good deal of work at this time. Such being the case the presentation of these more complete formulas are reserved for the future.

The prediction equations for the determination of the probable 365-day record from the 7-day record, where the 7-day record is a part of the 365-day record are given below. The equations are also found for the calculation of the probable 7-day record where the 365-day record is known. The numbers on which the equations for the milk yields at the ages older than seven years are based are small. The error in the use of these equations will consequently be large.

Prediction Equations for 365-Day Milk Yield from 7-Day Milk Yield, Same Lactation

365-day expected yield **7-day actual milk yield**

Milk yield 1 yr. 6 mo. to 2 yrs. 0 mo.=1122+35.1 **milk yield 1 yr. 6 mo. to 2 yrs. 0 mo.**
Milk yield 2 yrs. 0 mo. to 2 yrs. 6 mo.=3658+28.0 **milk yield 2 yrs. 0 mo. to 2 yrs. 6 mo.**
Milk yield 2 yrs. 6 mo. to 3 yrs. 0 mo.=4556+25.9 **milk yield 2 yrs. 6 mo. to 3 yrs. 0 mo.**
Milk yield 3 yrs. 0 mo. to 3 yrs. 6 mo.=10237+11.6 **milk yield 3 yrs. 0 mo. to 3 yrs. 6 mo.**
Milk yield 3 yrs. 6 mo. to 4 yrs. 0 mo.=4423+25.4 **milk yield 3 yrs. 6 mo. to 4 yrs. 0 mo.**
Milk yield 4 yrs. 0 mo. to 4 yrs. 6 mo.=—720+35.7 **milk yield 4 yrs. 0 mo. to 4 yrs. 6 mo.**
Milk yield 4 yrs. 6 mo. to 5 yrs. 0 mo.=9173+17.6 **milk yield 4 yrs. 6 mo. to 5 yrs. 0 mo.**
Milk yield 5 yrs. 0 mo. to 5 yrs. 6 mo.=3899+27.9 **milk yield 5 yrs. 0 mo. to 5 yrs. 6 mo.**
Milk yield 5 yrs. 6 mo. to 6 yrs. 0 mo.=4713+25.4 **milk yield 5 yrs. 6 mo. to 6 yrs. 0 mo.**
Milk yield 6 yrs. 0 mo. to 6 yrs. 6 mo.=4129+28.4 **milk yield 6 yrs. 0 mo. to 6 yrs. 6 mo.**
Milk yield 6 yrs. 6 mo. to 7 yrs. 0 mo.=5708+25.2 **milk yield 6 yrs. 6 mo. to 7 yrs. 0 mo.**
Milk yield 7 yrs. 0 mo. to 7 yrs. 6 mo.=8187+20.4 **milk yield 7 yrs. 0 mo. to 7 yrs. 6 mo.**
Milk yield 7 yrs. 6 mo. to 8 yrs. 0 mo.=—1016+38.9 **milk yield 7 yrs. 6 mo. to 8 yrs. 0 mo.**
Milk yield 8 yrs. 0 mo. to 8 yrs. 6 mo.=8843+17.1 **milk yield 8 yrs. 0 mo. to 8 yrs. 6 mo.**
Milk yield 8 yrs. 6 mo. to 9 yrs. 0 mo.=7657+19.6 **milk yield 8 yrs. 6 mo. to 9 yrs. 0 mo.**
Milk yield 9 yrs. 0 mo. to 9 yrs. 6 mo.=20087—3.5 **milk yield 9 yrs. 0 mo. to 9 yrs. 6 mo.**
Milk yield 9 yrs. 6 mo. to 11 yrs. 0 mo.=—1615+35.0 **milk yield 9 yrs. 6 mo. to 11 yrs. 0 mo.**
Milk yield 11 yrs. 0 mo. to 15 yrs. 0 mo.=—17618+69.4 milk yield 11 yrs. 0 mo. to 15 yrs. 0 mo.

Prediction Equations for 7-Day Milk Yield from 365-Day Milk Yield

7-day expected milk yield **365-day actual milk yield**

Milk yield 1 yr. 6 mo. to 2 yrs. 0 mo.=161+.0121 **milk yield 1 yr. 6 mo. to 2 yrs. 0 mo.**
Milk yield 2 yrs. 0 mo. to 2 yrs. 6 mo.=130+.0164 **milk yield 2 yrs. 0 mo. to 2 yrs. 6 mo.**
Milk yield 2 yrs. 6 mo. to 3 yrs. 0 mo.=158+.0151 **milk yield 2 yrs. 6 mo. to 3 yrs. 0 mo.**
Milk yield 3 yrs. 0 mo. to 3 yrs. 6 mo.=222+.0108 **milk yield 3 yrs. 0 mo. to 3 yrs. 6 mo.**
Milk yield 3 yrs. 6 mo. to 4 yrs. 0 mo.=195+.0153 **milk yield 3 yrs. 6 mo. to 4 yrs. 0 mo.**
Milk yield 4 yrs. 0 mo. to 4 yrs. 6 mo.=226+.0150 **milk yield 4 yrs. 0 mo to 4 yrs. 6 mo.**
Milk yield 4 yrs. 6 mo. to 5 yrs. 0 mo.=270+.0113 **milk yield 4 yrs. 6 mo. to 5 yrs. 0 mo.**
Milk yield 5 yrs. 0 mo. to 5 yrs. 6 mo.=278+.0122 **milk yield 5 yrs. 0 mo. to 5 yrs. 6 mo.**
Milk yield 5 yrs. 6 mo. to 6 yrs. 0 mo.=279+.0130 **milk yield 5 yrs. 6 mo. to 6 yrs. 0 mo.**
Milk yield 6 yrs. 0 mo. to 6 yrs. 6 mo.=237+.0142 **milk yield 6 yrs. 0 mo. to 6 yrs. 6 mo.**
Milk yield 6 yrs. 6 mo. to 7 yrs. 0 mo=259+.0136 **milk yield 6 yrs. 6 mo. to 7 yrs. 0 mo.**
Milk yield 7 yrs. 0 mo. to 7 yrs. 6 mo.=297+.0111 **milk yield 7 yrs. 0 mo. to 7 yrs. 6 mo.**
Milk yield 7 yrs. 6 mo. to 8 yrs. 0 mo.=207+.0162 **milk yield 7 yrs. 6 mo. to 8 yrs. 0 mo.**
Milk yield 8 yrs. 0 mo. to 8 yrs. 6 mo.=258+.0157 **milk yield 8 yrs. 0 mo. to 8 yrs. 6 mo.**
Milk yield 8 yrs. 6 mo. to 9 yrs. 0 mo.=266+.0138 **milk yield 8 yrs. 6 mo. to 9 yrs. 0 mo.**
Milk yield 9 yrs. 0 mo. to 9 yrs. 6 mo.=556—.0038 **milk yield 9 yrs. 0 mo. to 9 yrs. 6 mo.**
Milk yield 9 yrs. 6 mo. to 11 yrs. 0 mo.=259+.0156 **milk yield 9 yrs. 6 mo. to 11 yrs. 0 mo.**
Milk yield 11 yrs. 0 mo. to 15 yrs. 0 mo.=330+.0101 **milk yield 11 yrs. 0 mo. to 15 yrs. 0 mo.**

For purposes of illustration, the question may be asked, what will a cow five years old giving 500 pounds of milk in the 7-days be expected to give in 365-days. The equation for predicting the probable yield of the cow is

Milk yield 5 yrs. 0 mo. to 5 yrs. 6 mo.=3899+27.9 milk yield 5 yrs. 0 mo. to 5 yrs. 6 mo.

The milk yield of the cow, 500 pounds, times 27.9 equals 13950+3899=17849 as the probable milk yield of the cow in her 365-day lactation. For any given cow this figure is only approximate since there is a wide variation in the yields of milk of individual cows. Some cows will be more, some less, the figure given is a fair average.

The prediction equations for the 7-day and 365-day tests when the 7-day test is in a different lactation from the 365-day test are given below.

PREDICTION EQUATIONS FOR 365-DAY MILK YIELD FROM 7-DAY MILK YIELD, DIFFERENT LACTATIONS

365-day expected milk yield 7-day actual milk yield

Milk yield 3 yrs. to 4 yrs.=6115+28.6 milk yield 2 yrs. to 3 yrs.
Milk yield 4 yrs. to 5 yrs.=6851+27.8 milk yield 2 yrs. to 3 yrs.
Milk yield 5 yrs. to 6 yrs.=6725+33.2 milk yield 2 yrs. to 3 yrs.
Milk yield 6 yrs. to 10 yrs.=10065+25.3 milk yield 2 yrs. to 3 yrs.
Milk yield 4 yrs. to 5 yrs.=10445+14.1 milk yield 3 yrs. to 4 yrs.
Milk yield 5 yrs. to 6 yrs.=8594+22.6 milk yield 3 yrs. to 4 yrs.
Milk yield 6 yrs. to 10 yrs.=8374+27.0 milk yield 3 yrs. to 4 yrs.
Milk yield 5 yrs. to 6 yrs.=4684+28.8 milk yield 4 yrs. to 5 yrs.
Milk yield 6 yrs. to 10 yrs.=9400+19.2 milk yield 4 yrs. to 5 yrs.
Milk yield 6 yrs. to 10 yrs.=8214+21.5 milk yield 5 yrs. to 6 yrs.

PREDCTION EQUATIONS FOR 7-DAY MILK YIELD FROM 365-DAY MILK YIELD, DIFFERENT LACTATIONS

7-day expected milk yield 365-day actual yield

Milk yield 2 yrs. to 3 yrs.=229+.0071 milk yield 3 yrs. to 4 yrs.
Milk yield 2 yrs. to 3 yrs.=170+.0098 milk yield 4 yrs. to 5 yrs.
Milk yield 2 yrs. to 3 yrs.=142+.0106 milk yield 5 yrs. to 6 yrs.
Milk yield 2 yrs. to 3 yrs.=232+.0041 milk yield 6 yrs. to 10 yrs.
Milk yield 3 yrs. to 4 yrs.=285+.0072 milk yield 4 yrs. to 5 yrs.
Milk yield 3 yrs. to 4 yrs.=278+.0086 milk yield 5 yrs. to 6 yrs.
Milk yield 3 yrs. to 4 yrs.=156+.0114 milk yield 6 yrs. to 10 yrs.
Milk yield 4 yrs. to 5 yrs.=295+.0080 milk yield 5 yrs. to 6 yrs.
Milk yield 4 yrs. to 5 yrs.=72+.0210 milk yield 6 yrs. to 10 yrs.
Milk yield 5 yrs. to 6 yrs.=300+.0091 milk yield 6 yrs. to 10 yrs.

Care should be used in interpreting results derived from the use of the equation for three years to four years and six years to ten years as the numbers on which this equation is based are few.

One illustration of the use of these equations may be desirable. The two year old milk production of a cow for the 7-day test is 300 pounds, what 365-day milk production may be expected of this cow at 5 to 6 years of age. The equation expressing this relationship is

Milk yield 5 yrs. to 6 yrs.=6725+33.2 milk yield 2 yrs. to 3 yrs.
33.2 x 300 =9960.+6725=16685 as the probable milk yield of the cow.

PART II. RELATION BETWEEN THE 7-DAY BUTTER-FAT PERCENTAGE AND THE 365-DAY BUTTER-FAT PERCENTAGE

The data for the 7-day and the 365-day butter-fat percentages is the same as that used for the study of milk yields. The major problems involved and their method of treatment are given in the introduction. The order of treatment will be the same as that used in the exposition of milk yield. The means, standard deviations and coefficients of variation for the 365-day records when correlated with the 365-day retest records are given in Table 9.

TABLE 9.

Physical Constants for the Variation of 365-Day Butter-Fat Percentage in the Milk of Test and Retest Cows

Age Test Retest	Mean First Test	Standard Deviation First Test	Coefficients of Variation First Test
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	3.34±.02	.238±.017	7.12±.50
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	3.43±.03	.332±.023	9.67±.71
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	3.42±.03	.290±.021	8.47±.56
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	3.53±.05	.307±.035	8.70±1.02
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	3.44±.04	.352±.028	10.21±.80
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	3.34±.03	.330±.024	9.88±.73
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	3.42±.02	.284±.017	8.31±.46

Age Test Retest	Mean Retest	Standard Deviation Retest	Coefficients of Variation Retest
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	3.36±.03	.297±.021	8.85±.65
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	3.43±.03	.329±.023	9.61±.71
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	3.45±.03	.317±.023	9.20±.66
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	3.47±.05	.300±.034	8.65±1.02
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	3.48±.04	.319±.025	9.17±.72
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	3.41±.04	.343±.025	10.06±.73
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	3.39±.02	.284±.016	8.38±.46

The age of the Holstein-Friesian advanced registry cow does not materially effect the butter-fat percentage contained in her milk. Since this is the case the data on the butter-fat percentage could be lumped together for age without materially affecting the results. However, since these age divisions were used for the divisions of milk yield, it seems desirable to continue their use throughout this paper.

The mean butter-fat percentages for the first test cows agree closely with those of all 365-day tested Holstein-Friesian cows. The standard deviations of the butter-fat percentage of the 365-day test cows also agree closely with these constants for the 365-day test of all Holstein-Friesian cows. Such being the case the 365-day tested cows which were retested for the year period are a random sample of all Holstein-Friesian cows which are tested for the year period. In view of this fact the results of this study should be of general application to the Holstein-Friesian advanced registry cows as a whole. The retest cows have approximately the same average butter-fat percentage and standard devition of their butter-fat percentage as do the test cows. As noted in other papers the coefficients of variation of butter-fat percentage is only about ⅖ that of milk yield.

Table 10 presents the data for the relation of 7-day butter-fat percentage to the 365-day butter-fat percentage when both are of the same lactation.

Table 10 shows that the 7-day butter-fat percentage is in excess of the 365-day butter-fat percentage. This fact is one of the bones of contention, for it is argued that if the average butter-fat percentage of the 7-day test is higher than the year butter-fat percentage then reliance cannot be put upon the 7-day butter-fat percentage as an indicator of the probable 365-day butter-fat percentage. Unfortunately such reasoning is by no means necessarily true since it may be that all classes of cows, high or low testing, have their 7-day and 365-day butter-fat raised proportionately. The question is consequently on the relation between the two variables and not primarily a question of means.

The standard deviations of the butter-fat percentage are also higher than those of the 365-day test. This would indicate that either the 7-day test differentiates the cows' true producing capacities more accurately than the 365-day test or that the 7-day test of some cows may be increased in their butter-fat percentage through a trick of feeding or management while their equally good sisters are not increased. Here again the answer to the question comes in a study of the relations between the tests.

TABLE 10.

Physical Constants for the Variation of the 7-Day and 365-Day Butter-Fat Percentage when Both Tests are in the Same Lactation

Age	Mean 7-day Butter-Fat Percentage	Standard Deviation 7-day Butter-Fat Percentage	Coefficients of Variation 7-day Butter-Fat Percentage
1 yr. 6 mo. and 2 yrs. 0 mo.	3.59±.04	.386±.025	10.75±.73
2 yrs. 0 mo. and 2 yrs. 6 mo.	3.63±.02	.500±.013	13.80±.36
2 yrs. 6 mo. and 3 yrs. 0 mo.	3.68±.03	.527±.018	14.33±.48
3 yrs. 0 mo. and 3 yrs. 6 mo.	3.70±.03	.507±.022	13.71±.65
3 yrs. 6 mo. and 4 yrs. 0 mo.	3.62±.03	.466±.020	12.89±.57
4 yrs. 0 mo. and 4 yrs. 6 mo.	3.69±.04	.526±.028	14.25±.76
4 yrs. 6 mo. and 5 yrs. 0 mo.	3.68±.04	.491±.027	13.33±.72
5 yrs. 0 mo. and 5 yrs. 6 mo.	3.81±.05	.594±.033	15.61±.92
5 yrs. 6 mo. and 6 yrs. 0 mo.	3.64±.04	.550±.029	15.12±.82
6 yrs. 0 mo. and 6 yrs. 6 mo.	3.72±.04	.428±.029	11.52±.81
6 yrs. 6 mo. and 7 yrs. 0 mo.	3.65±.03	.361±.025	9.90±.69
7 yrs. 0 mo. and 7 yrs. 6 mo.	3.60±.06	.529±.040	14.72±1.16
7 yrs. 6 mo. and 8 yrs. 0 mo.	3.73±.09	.631±.063	16.92±1.74
8 yrs. 0 mo. and 8 yrs. 6 mo.	3.57±.05	.333±.037	9.35±1.02
8 yrs. 6 mo. and 9 yrs. 0 mo.	3.51±.08	.502±.058	14.28±1.65
9 yrs. 0 mo. and 9 yrs. 6 mo.	3.58±.15	.835±.103	23.33±2.98
9 yrs. 6 mo. and 11 yrs. 0 mo.	3.52±.05	.328±.038	9.31±1.05
11 yrs. 0 mo. and 15 yrs. 0 mo.	3.80±.09	.321±.063	8.46±1.57

Age	Mean 365-day Butter-Fat Percentage	Standard Deviation 365-day Butter-Fat Percentage	Coefficients of Variation 365-day Butter-Fat Percentage
1 yr. 6 mo. and 2 yrs. 0 mo.	3.50±.03	.293±.019	8.38±.53
2 yrs. 0 mo. and 2 yrs. 6 mo.	3.42±.01	.297±.008	8.67±.23
2 yrs. 6 mo. and 3 yrs. 0 mo.	3.51±.01	.310±.010	8.86±.31
3 yrs. 0 mo. and 3 yrs. 6 mo.	3.49±.02	.336±.015	9.64±.46
3 yrs. 6 mo. and 4 yrs. 0 mo.	3.42±.02	.312±.013	9.15±.39
4 yrs. 0 mo. and 4 yrs. 6 mo.	3.47±.03	.364±.019	10.49±.54
4 yrs. 6 mo. and 5 yrs. 0 mo.	3.41±.03	.337±.018	9.88±.55
5 yrs. 0 mo. and 5 yrs. 6 mo.	3.48±.03	.346±.019	9.94±.57
5 yrs. 6 mo. and 6 yrs. 0 mo.	3.40±.02	.270±.014	7.95±.43
6 yrs. 0 mo. and 6 yrs. 6 mo.	3.39±.02	.222±.015	6.53±.47
6 yrs. 6 mo. and 7 yrs. 0 mo.	3.42±.02	.245±.017	7.16±.48
7 yrs. 0 mo. and 7 yrs. 6 mo.	3.38±.03	.296±.022	8.76±.68
7 yrs. 6 mo. and 8 yrs. 0 mo.	3.46±.03	.236±.023	6.82±.70
8 yrs. 0 mo. and 8 yrs. 6 mo.	3.37±.03	.176±.020	5.24±.56
8 yrs. 6 mo. and 9 yrs. 0 mo.	3.41±.05	.315±.036	9.26±1.05
9 yrs. 0 mo. and 9 yrs. 6 mo.	3.39±.06	.349±.043	10.29±1.24
9 yrs. 6 mo. and 11 yrs. 0 mo.	3.43±.05	.314±.036	9.15±1.05
11 yrs. 0 mo. and 15 yrs. 0 mo.	3.40±.09	.342±.067	10.05±1.97

The physical constants for the 7-day and 365-day tests where the 7-day test is not a part of the 365-day test are given in Table 11.

TABLE 11.

Physical Constants for the Variation of the 7-Day and 365-Day Butter-Fat Percentage When the 7-Day Record is Made in a Separate Lactation from the 365-Day Record

Age 7-day test and 365-day test	Mean 7-day Butter-Fat Percentage	Standard Deviation 7-day Butter-Fat Percentage	Coefficients of Variation 7-day Butter-Fat Percentage
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	3.44±.04	.418±.026	12.15±.74
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	3.65±.05	.451±.035	12.37±.94
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	3.44±.05	.417±.038	12.13±1.12
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	3.49±.04	.369±.029	10.57±.87
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	3.59±.05	.436±.033	12.15±.93
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	3.51±.06	.461±.044	13.15±1.26
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	3.55±.06	.388±.043	10.93±1.22
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	3.57±.04	.343±.031	9.61±.91
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	3.61±.08	.601±.056	16.65±1.64
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	3.58±.05	.446±.039	12.46±1.06

Age 7-day test and 365-day test	Mean 365-day Butter-Fat Percentage	Standard Deviation 365-day Butter-Fat Percentage	Coefficients of Variation 365-day Butter-Fat Percentage
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	3.39±.03	.343±.021	10.11±.62
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	3.51±.03	.286±.022	8.16±.62
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	3.36±.04	.292±.027	8.70±.83
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	3.49±.04	.320±.025	9.17±.71
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	3.42±.03	.282±.022	8.25±.61
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	3.34±.04	.277±.026	8.30±.77
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	3.31±.04	.286±.031	8.65±.99
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	3.46±.04	.338±.030	9.77±.91
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	3.47±.05	.395±.037	11.38±1.04
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	3.46±.04	.332±.029	9.60±.88

The data for the 7-day and 365-day tests in different lactations show the 7-day butter-fat percentages to be slightly larger than the 365-day butter-fat percentage. The difference is about one-half as much as the difference between the 7-day and 365-day butter-fat percentage of the same lactations. The difference between the standard deviations of the 7-day and 365-day butter-fat percentages as shown in Table 11 for the different lactations is only about two-thirds the difference of the standard deviation for the 7-day and 365-day test of the same lactations. The differences in the relative variabilities are also less. From this fact it might be argued that the 7-day test gives a better index of the 365-day butter-fat percentage when it is not of the same lactation as the year test than when it is of the same lactation as the year test, but Table 12 shows such inferences are not justified.

RELATIVE MERITS OF THE 7-DAY AND 365-DAY BUTTER-FAT PERCENTAGE AS INDICATING THE COW'S PRODUCING CAPACITY

The relations between the year tests and retests and the 7-day tests and 365-day tests for butter-fat percentages as carried on in Holstein-Friesian advanced registry work are given in Table 12.

TABLE 12.

Correlation Coefficients for the Variables 365-Day Butter-Fat Percentage and 365-Day Butter-Fat Percentage for Different Lactations, 7-Day Butter-Fat Percentage and 365-Day Butter-Fat Percentage for the Same Lactation, 7-Day Butter-Fat Percentage and 365-Day Butter-Fat Percentage for Different Lactations

365-day Butter-fat Percentage and 365-day Butter-fat Percentage, Different Lactations. Age	Correlation Coefficients
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	.756±.043
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.789±.038
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	.593±.067
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.783±.062
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	.702±.057
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	.640±.061
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	.741±.036
Mean	.715

7-day Butter-fat Percentage and 365-day Butter-fat Percentage, Same Lactation. Age	Correlation Coefficients
1 yr. 6 mo. and 2 yrs. 0 mo.	.601±.059
2 yrs. 0 mo. and 2 yrs. 6 mo.	.559±.025
2 yrs. 6 mo. and 3 yrs. 0 mo.	.549±.033
3 yrs. 0 mo. and 3 yrs. 6 mo.	.539±.045
3 yrs. 6 mo. and 4 yrs. 0 mo.	.509±.045
4 yrs. 0 mo. and 4 yrs. 6 mo.	.540±.053
4 yrs. 6 mo. and 5 yrs. 0 mo.	.548±.054
5 yrs. 0 mo. and 5 yrs. 6 mo.	.636±.047
5 yrs. 6 mo. and 6 yrs. 0 mo.	.579±.050
6 yrs. 0 mo. and 6 yrs. 6 mo.	.381±.081
6 yrs. 6 mo. and 7 yrs. 0 mo.	.406±.080
7 yrs. 0 mo. and 7 yrs. 6 mo.	.628±.065
7 yrs. 6 mo. and 8 yrs. 0 mo.	.499±.106
8 yrs. 0 mo. and 8 yrs. 6 mo.	.643±.093
8 yrs. 6 mo. and 9 yrs. 0 mo.	.498±.123
9 yrs. 0 mo. and 9 yrs. 6 mo.	.505±.130
9 yrs. 6 mo. and 11 yrs. 0 mo.	.907±.029
11 yrs. 0 mo. and 15 yrs. 0 mo.	.030±.275
Mean	.531

7-day Butter-fat Percentage and 365-day Butter-fat Percentage, Different Lactations. Age	Correlation Coefficients
2 yrs. to 3 yrs. and 3 yrs. to 4 yrs.	.412±.072
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.355±.096
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	.478±.100
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	.329±.099
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.429±.088
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	.323±.121
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	.279±.143
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	.465±.100
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	.630±.080
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	.534±.088
Mean	.423

The yearly butter-fat percentage is clearly a better measure of a subsequent yearly butter-fat percentage than a 7-day butter-fat percentage is a measure of a subsequent year butter-fat percentage. This holds true whether the 7-day test is a part of the 365-day test or is in a different lactation.

The 7-day test is a better measure of the butter-fat percentage of the 365-day lactation record of which it is a part than it is a measure of the 365-day lactation record of which it is not a part.

All of the correlation coefficients are of good size showing that records as short as 7-days have a good deal of value in predicting what the probable butter-fat percentage of the cow will be under year test conditions.

LINEARITY OF REGRESSION

Before placing too much emphasis on the constants derived above it is desirable to know the character of the regression lines. The correlation ratios and the test for the linearity of regression, correlation ratio squared minus the correlation coefficient squared, are given in Table 13.

TABLE 13.

Data for the Linearity of Regression Test for the Tables Whose Correlation Coefficients are Presented in Table 17

365-day Butter-fat Percentage and 365-day Butter-fat Percentage, Different Lactations Age	Correlation Ratios	η^2-r^2
1 yr. 9 mo. to 3 yrs. and 3 yrs. to 4 yrs.	.787	.049±.043
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.859	.115±.063
2 yrs. to 3 yrs. and 5 yrs. to 8 yrs.	.681	.112±.065
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.843	.097±.094
3 yrs. to 4 yrs. and 5 yrs. to 8 yrs.	.767	.094±.066
4 yrs. to 5 yrs. and 5 yrs. to 11 yrs.	.767	.178±.079
5 yrs. to 11 yrs. and 6 yrs. to 13 yrs.	.772	.047±.034
Average	.782	

7-day Butter-fat Percentage and 365-day Butter-fat Percentage, Same Lactation. Age	Correlation Ratios	η^2-r^2
1 yr. 6 mo. and 2 yrs. 0 mo.	.684	.108±.057
2 yrs. 0 mo. and 2 yrs. 6 mo.	.592	.039±.014
2 yrs. 6 mo. and 3 yrs. 0 mo.	.597	.055±.022
3 yrs. 0 mo. and 3 yrs. 6 mo.	.719	.226±.054
3 yrs. 6 mo. and 4 yrs. 0 mo.	.581	.078±.033
4 yrs. 0 mo. and 4 yrs. 6 mo.	.686	.179±.057
4 yrs. 6 mo. and 5 yrs. 0 mo.	.653	.126±.051
5 yrs. 0 mo. and 5 yrs. 6 mo.	.731	.130±.054
5 yrs. 6 mo. and 6 yrs. 0 mo.	.713	.173±.057
6 yrs. 0 mo. and 6 yrs. 6 mo.	.442	.050±.041
6 yrs. 6 mo. and 7 yrs. 0 mo.	.551	.139±.067
7 yrs. 0 mo. and 7 yrs. 6 mo.	.705	.102±.065
7 yrs. 6 mo. and 8 yrs. 0 mo.	.678	.210±.115
8 yrs. 0 mo. and 8 yrs. 6 mo.	.715	.099±.095
8 yrs. 6 mo. and 9 yrs. 0 mo.	.706	.251±.142
9 yrs. 0 mo. and 9 yrs. 6 mo.	.942	.632±.168
9 yrs. 6 mo. and 11 yrs. 0 mo.	.952	.084±.091
11 yrs. 0 mo. and 15 yrs. 0 mo.	.218	.047±.116
Average	.659	

7-day Butter-fat Percentage and 365-day Butter-fat Percentage, Different Lactations. Age	Correlation Ratios	η^2-r^2
2 yrs. to 3 yrs and 3 yrs. to 4 yrs.	.596	.152±.062
2 yrs. to 3 yrs. and 4 yrs. to 5 yrs.	.561	.043±.044
2 yrs. to 3 yrs. and 5 yrs. to 6 yrs.	.669	.097±.077
2 yrs. to 3 yrs. and 6 yrs. to 10 yrs.	.388	.047±.047
3 yrs. to 4 yrs. and 4 yrs. to 5 yrs.	.455	.106±.067
3 yrs. to 4 yrs. and 5 yrs. to 6 yrs.	.527	.084±.075
3 yrs. to 4 yrs. and 6 yrs. to 10 yrs.	.785	.307±.143
4 yrs. to 5 yrs. and 5 yrs. to 6 yrs.	.738	.315±.118
4 yrs. to 5 yrs. and 6 yrs. to 10 yrs.	.666	.039±.052
5 yrs. to 6 yrs. and 6 yrs. to 10 yrs.	.587	.150±.088
Average	.597	

The correlation ratios, shown in Table 13 are all large. The order of worth of the 365-day and 7-day test as indicators of the year butter-fat percentages is the same as that for Table 12. The difference between the correlation ratios squared and the correlation coefficients squared are practically all under three times the probable error of the differences. Such being the case it is probable that all regression lines are linear.

RELATION SHOWN BETWEEN ECONOMIC CHARACTERS

If an event can be foreseen it can more often be utilized to advantage than if it appears unannounced. If the profitable cow can be selected from the unprofitable cow, or the high laying hen from the poor layer early in life it follows that a profit is made by keeping the first and discarding the second. Such reasons justify the retention of any characters which indicate the subsequent productive value of an animal. The 7-day and 365-day tests have value in predicting future butter-fat percentage. It is of interest to examine some of the other variables used to predict economic characters. Some of these constants are given in Table 6. Those more nearly relating to butter-fat percentage are given in Table 14.

TABLE 14.

Correlation Coefficients Between Characters of Economic Importance

Character	Breed	Correlation	Authority
Butter-fat percentage and butter-fat percentage	Guernsey Advanced Registry	.637 to .893	Gowen[1]
Butter-fat percentage and butter-fat percentage	Jersey pure-bred herd	.247 to .678	Gowen[2]
365-day butter-fat percentage and 365-day butter-fat percentage	Holstein-Friesian Advanced Registry	.593 to .789	This paper
7-day butter-fat percentage and 365-day butter-fat percentage (same lactation)	Holstein-Friesian Advanced Registry	.030 to .907	This paper
7-day butter-fat percentage and 365-day butter-fat percentage (different lactation)	Holstein-Friesian Advanced Registry	.279 to .630	This paper

The characters in Table 14 deal entirely with the concentration of the butter-fat contained in cow's milk. The average correlation coefficients for each variable is of good size. The value of the year test in predicting the year retest butter-fat percentage is nearly the same for the Guernsey and Holstein-Friesian advanced registry cows. The eight months butter-fat percentage record of the pure bred Jersey herd has a lower prediction value for the subsequent eight months record than either the Guernsey or Holstein-Friesian year test have for the subsequent retest. It is believed that this lower value is due to the fact that all of the eight months records were for a pure bred Jersey herd under average conditions whereas the Guernsey and Holstein-Friesian cows were a selected group kept under more careful treatment. The 7-day records have a slightly lower predicting value than do the 365-day records.

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[1] Gowen, John W. 1921. Studies in Milk Secretion XI. The Relation between the Butter-Fat Percentage of One Lactation and the Butter-Fat Percentage of a subsequent Lactation in Guernsey Advanced Registry Cattle. In press.

[2] ——————— 1920. Studies in Milk Secretion VI. On the Variations and Correlations of Butter-Fat Percentage with Age in Jersey Cattle. Genetics, Vol. 5, p. 249-324.

If the reader turns back to Table 6 and compares the values given in this table with those of Table 14 it will be noted that the year records for milk yield of both the Guernsey and Holstein-Friesian cows have nearly the same predicting value for subsequent milk yield that the butter-fat percentages have for the subsequent butter-fat percentage. The 7-day milk yields have a slightly higher value in predicting the subsequent 365-day records than the 7-day records for butter-fat percentage have for predicting the subsequent 365-day butter-fat percentage. When compared with the other characters used to predict future productions it is clear that both the 7-day and 365-day records have a relatively high value in predicting future production of dairy cattle, well up with those used for egg production and for wool clip.

As noted in Table 6 conformation of the cow is frequently used as a criterion to select cows as milkers. The relation of conformation to milk yield is significant but low compared with the relation of either the 7-day or the 365-day tests to a subsequent 365-day record. The case is worse for butter-fat percentage. Conformation has little or no relation to butter-fat percentage. Under such conditions we are thrown back on a butter-fat test of either long or short duration to determine the probable productive ability of the cow.

EFFECT OF GROUPING ALL BUTTER-FAT PERCENTAGE RECORDS IN DETERMINING THE RELATION OF THE 7-DAY AND 365-DAY LACTATION RECORDS

The lumping together of all records for butter-fat percentage irrespective of age has very little effect on the correlation coefficients for the 7-day and 365-day butter-fat percentage. This comes from the fact that in Holstein-Friesian cows there is very little correlation between the age of the cow and the butter-fat percentage contained in her milk. The correlation coefficients obtained by grouping all records together are given in Table 15.

TABLE 15.

Correlation Coefficients Between 7-Day and 365-Day Butter-Fat Percentage, the Age of the Cow Disregarded

Characters Correlated	Correlation Coefficients
365-day butter-fat percentage and 365-day butter-fat percentage	.707±.019
7-day butter-fat percentage and 365-day butter-fat percentage (same lactation)	.547±.018
7-day butter-fat percentage and 365-day butter-fat percentage (different lactation)	.477±.024

The results derived from the combination of all data are essentially the same as those where the individual age group are made. The reason for this comes from the fact that age changes do not materially effect the butter-fat percentage of the milk of Holstein-Friesian cows.

CHANGES IN THE VALUE OF THE 7-DAY TEST AS AN INDICATOR OF THE YEAR TEST BUTTER-FAT PERCENTAGE

The claim is made that in recent years the record of the 7-day test may be so modified by feeding, as to be worthless as an indication of the cow's 365-day production. This assertion is directed more particularly at the butter-fat percentage. It is based on the belief that the early records were not influenced by this factor whereas the records of today are materially affected. The critical evidence for testing the truth of this claim comes from a comparison of the correlation coefficients for the 7-day and 365-day records for a group of cows tested early in the history of advanced registry testing with the same coefficients for another group tested just recently. The data used for this point were the 2-year old and the 6- to 9-year old records of cows tested for the 7- and 365-days in the same lactation. Such a division gives a group of young cows and a group of mature cows for comparison. The data on each group were divided into approximately two equal parts. The first group for the 2-year olds contained herd book numbers from 66417 to 159419, the second group contained numbers from 159486 to 211236. The groups for the 6- to 9-year old cows contained numbers from 49440 to 95253 and 95273 to 158760.

Consideration of the problem shows that if the claim made is correct the groups of cows with the lower herd book numbers should have a higher relation between the 7-day and 365-day records than that found for the correlation between the 7-day and 365-day test with the cows of the higher herd book numbers. If on the other hand there is nothing to the assertion no significant difference should exist between these correlation coefficients. The constants for these relations are given in Table 16.

TABLE 16.

Correlation Coefficients for the 7-Day and 365-Day Butter-Fat Percentage, Grouped to Determine the Relation Between Tests Made Recently and Tests Made Early in the Breed's History in Predicting Probable Future 365-Day Lactation Records for Butter-Fat

Characters Correlated	Correlation Coefficients	Difference
7-day and 365-day butter-fat percentages		
Cows 2-years old		
Herd book Nos. 66417 to 159419	.542±.028	
Herd book Nos. 159486 to 211236	.582±.027	—.040±.039
Cows 6- to 9-years old		
Herd book Nos. 49440 to 95253	.695±.030	
Herd book Nos. 95273 to 158760	.592±.038	.103±.048

The difference in the 2-year old group favor the test of today as the most reliable. The difference for the mature cows favors the 7-day test as applied some years ago. The difference between the correlation coefficients for the early tested and the later tested groups is not significant for either group. Such being the case, the claim that the value of the 7-day test as an indicator of the 365-day test has become less in recent years is not in line with the facts.

PREDICTION EQUATIONS TO DETERMINE THE PROBABLE 365-DAY LACTATION BUTTER-FAT PERCENTAGE FROM THE 7-DAY OR 365-DAY RECORDS

As indicated earlier in this paper one of the chief criticisms of the 7-day test comes from the fact that the prediction equations to determine the probable 365-day test from the 7-day test are not known, e. g. the criticism of the 7-day test because it has a higher average butter-fat percentage than the year test. From the data and constants given in the earlier sections of this paper it is possible to form these prediction equations for the 7-day and for the 365-day records.

The prediction equations for the 365-day butter-fat percentage from a previous 365-day lactation's butter-fat percentage are given below. The same caution should be used in the use of these equations as was noted under milk yield.

365-day expected butter-fat percentage at given age 365-day retest at given age

Butter-fat percentage 1 yr. 9 mo. to 3 yrs.=1.31+.606 Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 2 yrs. to 3 yrs.=.71+.794 Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 2 yrs. to 3 yrs.=1.55+.542 Butter-fat percentage 5 yrs. to 8 yrs.
Butter-fat percentage 3 yrs. to 4 yrs.=.75+.802 Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 3 yrs. to 4 yrs.=.75+.774 Butter-fat percentage 5 yrs. to 8 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=1.24+.616 Butter-fat percentage 5 yrs. to 11 yrs.
Butter-fat percentage 5 yrs. to 11 yrs.=.91+.740 Butter-fat percentage 6 yrs. to 13 yrs.

365-retest expected butter-fat percentage at given age 365-day butter-fat percentage at given age

Butter-fat percentage 3 yrs. to 4 yrs.=.21+.943 Butter-fat percentage 1 yr. 9 mo. to 3 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=.74+.784 Butter-fat percentage 2 yrs. to 3 yrs.
Butter-fat percentage 5 yrs. to 8 yrs.=1.23+.650 Butter-fat percentage 2 yrs. to 3 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=.76+.765 Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 5 yrs. to 8 yrs.=1.28+.637 Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 5 yrs. to 11 yrs.=1.19+.666 Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 6 yrs. to 13 yrs.=.86+.742 Butter-fat percentage 5 yrs. to 11 yrs.

As an illustration of the use of these equations we may suppose the case of a cow 2 years old giving in her 365-day test a milk testing 4.0 per cent, what would be her probable butter-fat test at 4 to 5 years of age. The equation to make the desired prediction is

Butter-fat percentage 4 yrs. to 5 yrs.=.74+.784 Butter-fat percentage 2 yrs. to 3 yrs.

Multiplying the 2 year butter-fat percentage, 4.0 by .784 we have 3.14+.74=3.88 as the probable butter-fat test of the second lactation.

The equation for the determination of the probable 365-day record from the 7-day record, when the 7-day record is a part of the 365-day record, are given below. The equations are also formed for the calculation of the probable 7-day record when the 365-day record is known.

365-day expected butter-fat percentage at given age		7-day actual butter-fat percentage
Butter-fat percentage 1 yr. 6 mo. to 2 yrs. 0 mo.	=1.86+.457	Butter-fat percentage 1 yr. 6 mo. to 2 yrs. 0 mo.
Butter-fat percentage 2 yrs. 0 mo. to 2 yrs. 6 mo.	=2.22+.331	Butter-fat percentage 2 yrs. 0 mo. to 2 yrs. 6 mo.
Butter-fat percentage 2 yrs. 6 mo. to 3 yrs. 0 mo.	=2.32+.324	Butter-fat percentage 2 yrs. 6 mo. to 3 yrs. 0 mo.
Butter-fat percentage 3 yrs. 0 mo. to 3 yrs. 6 mo.	=2.16+.357	Butter-fat percentage 3 yrs. 0 mo. to 3 yrs. 6 mo.
Butter-fat percentage 3 yrs. 6 mo. to 4 yrs. 0 mo.	=2.18+.341	Butter-fat percentage 3 yrs. 6 mo. to 4 yrs. 0 mo.
Butter-fat percentage 4 yrs. 0 mo. to 4 yrs. 6 mo.	=2.09+.374	Butter-fat percentage 4 yrs. 0 mo. to 4 yrs. 6 mo.
Butter-fat percentage 4 yrs. 6 mo. to 5 yrs. 0 mo.	=2.03+.377	Butter-fat percentage 4 yrs. 6 mo. to 5 yrs. 0 mo.
Butter-fat percentage 5 yrs. 0 mo. to 5 yrs. 6 mo.	=2.07+.370	Butter-fat percentage 5 yrs. 0 mo. to 5 yrs. 6 mo.
Butter-fat percentage 5 yrs. 6 mo. to 6 yrs. 0 mo.	=2.36+.285	Butter-fat percentage 5 yrs. 6 mo. to 6 yrs. 0 mo.
Butter-fat percentage 6 yrs. 0 mo. to 6 yrs. 6 mo.	=2.66+.197	Butter-fat percentage 6 yrs. 0 mo. to 6 yrs. 6 mo.
Butter-fat percentage 6 yrs. 6 mo. to 7 yrs. 0 mo.	=2.42+.276	Butter-fat percentage 6 yrs. 6 mo. to 7 yrs. 0 mo.
Butter-fat percentage 7 yrs. 0 mo. to 7 yrs. 6 mo.	=2.12+.351	Butter-fat percentage 7 yrs. 0 mo. to 7 yrs. 6 mo.
Butter-fat percentage 7 yrs. 6 mo. to 8 yrs. 0 mo.	=2.76+.187	Butter-fat percentage 7 yrs. 6 mo. to 8 yrs. 0 mo.
Butter-fat percentage 8 yrs. 0 mo. to 8 yrs. 6 mo.	=2.15+.340	Butter-fat percentage 8 yrs. 0 mo. to 8 yrs. 6 mo.
Butter-fat percentage 8 yrs. 6 mo. to 9 yrs. 0 mo.	=2.31+.313	Butter-fat percentage 8 yrs. 6 mo. to 9 yrs. 0 mo.
Butter-fat percentage 9 yrs. 0 mo. to 9 yrs. 6 mo.	=2.64+.211	Butter-fat percentage 9 yrs. 0 mo. to 9 yrs. 6 mo.
Butter-fat percentage 9 yrs. 6 mo. to 11 yrs. 0 mo.	= .37+.867	Butter-fat percentage 9 yrs. 6 mo. to 11 yrs. 0 mo.
Butter-fat percentage 11 yrs. 0 mo to 15 yrs. 0 mo.	=3.28+.032	Butter-fat percentage 11 yrs. 0 mo. to 15 yrs. 0 mo.

PREDICTION EQUATIONS FOR 7-DAY BUTTER-FAT PERCENTAGE FROM THE 365-DAY BUTTER-FAT PERCENTAGE

7-day expected butter-fat percentage at given age	365-day actual butter-fat percentage
Butter-fat percentage 1 yr. 6 mo. to 2 yrs. 0 mo.= .82+ .789	Butter-fat percentage 1 yr. 6 mo. to 2 yrs. 0 mo.
Butter-fat percentage 2 yrs. 0 mo. to 2 yrs. 6 mo.= .40+ .942	Butter-fat percentage 2 yrs. 0 mo. to 2 yrs. 6 mo.
Butter-fat percentage 2 yrs. 6 mo. to 3 yrs. 0 mo.= .41+ .932	Butter-fat percentage 2 yrs. 6 mo. to 3 yrs. 0 mo.
Butter-fat percentage 3 yrs. 0 mo. to 3 yrs. 6 mo.= .86+ .814	Butter-fat percentage 3 yrs. 0 mo. to 3 yrs. 6 mo.
Butter-fat percentage 3 yrs. 6 mo. to 4 yrs. 0 mo.= 1.02+ .760	Butter-fat percentage 3 yrs. 6 mo. to 4 yrs. 0 mo.
Butter-fat percentage 4 yrs. 0 mo. to 4 yrs. 6 mo.= .98+ .781	Butter-fat percentage 4 yrs. 0 mo. to 4 yrs. 6 mo.
Butter-fat percentage 4 yrs. 6 mo. to 5 yrs. 0 mo.= .96+ .798	Butter-fat percentage 4 yrs. 6 mo. to 5 yrs. 0 mo.
Butter-fat percentage 5 yrs. 0 mo. to 5 yrs. 6 mo.= .00+1.093	Butter-fat percentage 5 yrs. 0 mo. to 5 yrs. 6 mo.
Butter-fat percentage 5 yrs. 6 mo. to 6 yrs. 0 mo.=— .37+1.179	Butter-fat percentage 5 yrs. 6 mo. to 6 yrs. 0 mo.
Butter-fat percentage 6 yrs. 0 mo. to 6 yrs. 6 mo.= 1.22+ .735	Butter-fat percentage 6 yrs. 0 mo. to 6 yrs. 6 mo.
Butter-fat percentage 6 yrs. 6 mo. to 7 yrs. 0 mo.= 1.60+ .597	Butter-fat percentage 6 yrs. 6 mo. to 7 yrs. 0 mo.
Butter-fat percentage 7 yrs. 0 mo. to 7 yrs. 6 mo.=— .20+1.123	Butter-fat percentage 7 yrs. 0 mo. to 7 yrs. 6 mo.
Butter-fat percentage 7 yrs. 6 mo. to 8 yrs. 0 mo.=— .89+1.337	Butter-fat percentage 7 yrs. 6 mo. to 8 yrs. 0 mo.
Butter-fat percentage 8 yrs. 0 mo. to 8 yrs. 6 mo.=— .52+1.214	Butter-fat percentage 8 yrs. 0 mo. to 8 yrs. 6 mo.
Butter-fat percentage 8 yrs. 6 mo. to 9 yrs. 0 mo.= .81+ .792	Butter-fat percentage 8 yrs. 6 mo. to 9 yrs. 0 mo.
Butter-fat percentage 9 yrs. 0 mo. to 9 yrs. 6 mo.=— .52+1.207	Butter-fat percentage 9 yrs. 0 mo. to 9 yrs. 6 mo.
Butter-fat percentage 9 yrs. 6 mo. to 11 yrs. 0 mo.= .27+ .948	Butter-fat percentage 9 yrs. 6 mo. to 11 yrs. 0 mo.
Butter-fat percentage 11 yrs. 0 mo. to 15 yrs. 0 mo.= 3.70+ .029	Butter-fat percentage 11 yrs. 0 mo. to 15 yrs. 0 mo.

As an illustration of the use of these equations, the question may be asked what butter-fat percentage would a cow be likely to give in her milk in the 365-day test if her 7-day test was 4.0 per cent, the age of the cow being 4 years 3 months. The equation for the prediction of the year test record is

Butter-fat percentage 4 yrs. 0 mo. to 4 yrs. 6 mo.=2.09+.374 Butter-fat percentage 4 yrs. 0 mo. to 4 yrs. 6 mo.
.374 x 4.0=1.50+2.09=3.59 the expected butter-fat percentage of the year test.

The prediction equations for the 7-day and 365-day butter-fat percentage test when the 7-day test is in a different lactation from the 365-day test are given below.

365-day expected butter-fat percentage	7-day actual butter-fat percentage
Butter-fat percentage 3 yrs. to 4 yrs.=2.23+.337	Butter-fat percentage 2 yrs. to 3 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=2.69+.225	Butter-fat percentage 2 yrs. to 3 yrs.
Butter-fat percentage 5 yrs. to 6 yrs.=2.21+.335	Butter-fat percentage 2 yrs. to 3 yrs.
Butter-fat percentage 6 yrs. to 10 yrs.=2.50+.286	Butter-fat percentage 2 yrs. to 3 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=2.42+.276	Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 5 yrs. to 6 yrs.=2.66+.194	Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 6 yrs. to 10 yrs.=2.58+.206	Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 5 yrs. to 6 yrs.=1.83+.457	Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 6 yrs. to 10 yrs.=1.97+.414	Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 6 yrs. to 10 yrs.=2.03+.398	Butter-fat percentage 5 yrs. to 6 yrs.

PREDICTION EQUATIONS TO DETERMINE THE 7-DAY BUTTER-FAT PERCENTAGE FROM 365-DAY BUTTER-FAT PERCENTAGE, DIFFERENT LACTATIONS

7-day expected butter-fat percentage	365-day actual butter-fat percentage
Butter-fat percentage 2 yrs. to 3 yrs.=1.74+.502	Butter-fat percentage 3 yrs. to 4 yrs.
Butter-fat percentage 2 yrs. to 3 yrs.=1.69+.559	Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 2 yrs. to 3 yrs.=1.15+.683	Butter-fat percentage 5 yrs. to 6 yrs.
Butter-fat percentage 2 yrs. to 3 yrs.=2.17+.378	Butter-fat percentage 6 yrs. to 10 yrs.
Butter-fat percentage 3 yrs. to 4 yrs.=1.32+.664	Butter-fat percentage 4 yrs. to 5 yrs.
Butter-fat percentage 3 yrs. to 4 yrs.=1.71+.537	Butter-fat percentage 5 yrs. to 6 yrs.
Butter-fat percentage 3 yrs. to 4 yrs.=2.30+.378	Butter-fat percentage 6 yrs. to 10 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=1.94+.472	Butter-fat percentage 5 yrs. to 6 yrs.
Butter-fat percentage 4 yrs. to 5 yrs.=.28+.958	Butter-fat percentage 6 yrs. to 10 yrs.
Butter-fat percentage 5 yrs. to 6yrs.=1.10+.717	Butter-fat percentage 6 yrs. to 10 yrs.

The use of these equations is entirely similar to any of the others illustrated above. If a cow gives a 4 per cent milk in the 7-day test at 2-years old, what will be her probable butter-fat test in her 5 year old 365-day lactation. The equation for this is

Butter-fat percentage 5 yrs. to 6 yrs.=2.21+.335 butter-fat percentage 2 yrs. to 3 yrs.
.335 x 4.0=1.34+2.21=3.55 the probable butter-fat test in the 5 year old 365-day lactation.

The butter-fat yield of a cow is dependent on the amount of milk the cow yields and on the butter-fat percentage contained in the milk. The primary variables are consequently milk yield and butter-fat percentage. As these variables have been treated in the previous sections it does not seem essential to the good of the dairy industry to give the analysis of the secondary variable, amount of butter-fat. This is especially true in view of the fact that the results of the analysis of the butter-fat are in agreement with those given for the primary variables milk yield and butter-fat percentage. The prediction of the probable butter-fat yield may be obtained from equations formed directly or it may be determined from the equations for milk yield and for butter-fat percentage as previously given. While the second method is somewhat longer it seems to be the better because it focuses the attention on the prime variables, milk yield and butter-fat percentage.

BEARING OF THESE RESULTS ON THE GENERAL PROBLEM OF TESTING DAIRY CATTLE

Another quantitative study has been made of certain phases of the problem of advanced registry testing by Mr. Yapp. Among other points not discussed in this paper but analyzed by Mr. Yapp are the accuracy of the semi-official test, the relation between the butter-fat test of the 7-day period to the 7-day butter-fat, the relation between the 365-day butter-fat percentage and the 365-day butter-fat, the comparison between the 7-day and 30-day butter-fat percentage and the 7-day test and 7-day test eight months after calving.

He shows on a herd of 30 cows kept at the University of Illinois that the butter-fat test by the semi-official method agrees closely with the butter-fat test of these cows kept on continuous test. From this the deduction is drawn that the semi-official test is a fairly accurate measure of the producing ability of the cow. Such an analysis does not quite answer the problem, however. What we really wish to know is how much the 365-day semi-official test may be influenced by the same or like methods which are claimed to influence the 7-day test. That the semi-official record may be influenced by feeding and management can, we think, be proved. The proof of this statement is circumstantial rather than direct. If the names of the cows who are high in butter-fat percentage be tabulated (and this applies to most breeds) it will be found that the same man's name appears time and again as owner of these cows at the time they were tested. Furthermore this man may have bred few or none of these cows. Not only that but they come from different families often of diverse breeding. Under these circumstances heredity could have little to do with the cow's butter-fat percentage, in fact the conclusion is almost irresistible that feeding and care have influenced the test.

The authors know of no adequate data to approach the solution of the amount by which the semi-official record may be influenced by feeding and management. The official records offer no criterion as there would be no inducement for a feeder to raise the monthly test above the average of the official test. It might be possible to get some notion of the amount of this effect by a comparison of a semi-official record and another official record of different lactations for the same cow. Such records are scarce and are quite unsatisfactory as many semi-official tested cows may not be subjected to the trick of feeding or management which will cause the test to increase beyond the point which would indicate the cow's true production for all her milk in the year.

Mr. Yapp shows the 7-day butter-fat percentage to have a greater relation to the 7-day butter-fat (correlation ratio=.43[9]) than the 365-day butter-fat percentage has with the 365-day butter-fat (correlation ratio=.26[9]).

In a comparison of the 7-day test and the 30-day test Mr. Yapp finds that the 7-day butter-fat percentage parallels the 30-day butter-fat percentage but is between .1 to .25 per cent of butter-fat above the 30-day percentage.

The present paper shows that the coefficients of variation for the 7-day test's milk production are less than are the coefficients of variation for the 365-day test's milk production. This is true whether the 7-day test is a part of the 365-day test or is in a separate lactation. The coefficients of variation for the 7-day test's butter-fat percentage are larger than the coefficients of variation for the 365-day test's butter-fat percentage, and this holds true whether the 7-day test is a part of the 365-day test or is in a separate lactation from it. Such results do not assist materially in the evaluation of the 7-day test or the 365-day test as the better-measure of the cow's productive capacity. The mean butter-fat percentage of the 7-day test is higher than the 365-day test. This offers no criterion between the two tests for why should we expect the two tests to be the same. We do not expect the 7-day milk yield to equal the 365-day milk yield. It merely shows us that necessary adjuncts to each of these tests are the conversion factors to determine the probable record of one test from the known record of the other.

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[9] Calculated by the authors of this paper from Mr. Yapp's data.

The whole question hinges largely upon the relative amounts of correlation between the 7-day and the 365-day tests. The correlation coefficients for the 365-day test with the 365-day test are high for both the milk yield and butter-fat percentage. The correlation coefficients between the 7-day and 365-day tests of which the 7-day test is a part of the 365-day are also high but not so large as those for the year test and retest. The correlation coefficients for the 7-day and 365-day tests where the 7-day test is not a part of the 365-day test are also large. They are less than either of the two preceding correlation coefficients, however. These results are based on age divided records so that the effect of age on milk yield should be largely eliminated.

As all regressions are linear the correlation coefficients should closely represent the true relation between the variables.

The grouping of all records together changes the order of merit of the 7-day and 365-day tests. This is due largely to age, the data becoming heterogeneous because of the shift in the mean milk yield of any group of cows with advancing age.

When the data for the two-year olds and the six-to nine-year olds are divided to give two nearly equal groups, the first tested early in the breed's history and the second tested recently, and a comparison made for these groups it is seen that the 7-day test is as good an indicator of the 365-day's production today as it was when the tests were first used.

The real merits of the 7-day and the 365-day records as measures of the cow's producing ability can be properly determined only by comparison with similar variables used to predict other events. The relative merits of the 365-day records for milk yield or butter-fat percentage as indicators of the probable 365-day records for milk yield or butter-fat percentage are practically the same. The value of these records in predicting subsequent records is also closely similar to those for the same variables in Guernsey advanced registry cattle. The advanced registry records have a greater predicting value for subsequent long time records than similar records for a pure bred Jersey herd have for predicting subsequent production. The 365-day records are more accurate in predicting the probable milk yield of a subsequent 365-day record than any point in the cow's conformation, not only that but the butter-fat test on this milk indicates quite clearly the cow's probable butter-fat test at some future lactation whereas conformation does not. The 365-day record is a better indicator of a subsequent lactation record than the egg production of one month is of the egg production of a year, or the wool clip of one season is of the wool clip of another season.

The 7-day record predicts the probable 365-day record of which it is a part more accurately than it does the 365-day record of which it is not a part. It has a prediction value slightly less than that of the 365-day test. The 7-day test for milk yield and butter-fat percentage have a value in predicting 365-day milk yield and butter-fat percentage closely similar to that of the wool clip of one season with the wool clip of another season or an egg production of a month for the egg production of a year. The value of the 7-day test is much greater than the value of any point in conformation in predicting milk yield or butter-fat percentage. From this comparison the 7-day record is clearly valuable in predicting the cow's subsequent production. It is not quite so valuable as the 365-day test applied to this same purpose. Both records seem to have merits unto themselves and a predicting value high enough to be worthy of retention.

The value of these different forms of records comes chiefly in knowing the conversion factors necessary to give the probable subsequent production. These conversion factors show that there is no particular detriment in the fact that the 7-day butter-fat percentage is slightly in access of the 365-day butter-fat percentage.

It was hoped to publish the correlation tables showing the data, in an easily checked form, on which these conclusions are based. The cost of printing has made this impossible. The tables will be available, however, at this station. Furthermore the tables can be easily reformed from the data given in the Advanced Registries.

BULLETIN 307

STERILITY RELATIONSHIPS IN MAINE APPLE VARIETIES.[1]

Karl Sax

SUMMARY

1. Apple blossoms emasculated by removing the anthers and petals and left exposed to wind and insects will rarely set fruit because wind is not effective in cross-pollinating apples, and insects do not visit flowers which have no petals. This knowledge is of value in cross-pollination work.

2. For practical purposes all commercial varieties of apples grown extensively in Maine are self-sterile and must be pollinated with pollen of compatible varieties to set a normal crop.

3. The sterility relationships of all combinations of the following varieties have been determined,—Ben Davis, Baldwin, Golden Russett, Rhode Island Greening, Northern Spy and McIntosh. Some results are also presented for Delicious, Wealthy, Gravenstein and Red Astrachan.

4. With the exception of Greening and also the Baldwin as the pollen parent, any combination of the first six varieties noted above are inter-fertile.

5. Insects are absolutely essential in transmitting pollen from one variety to another, but good crops have been obtained in large blocks of self-sterile varieties where bumble bees were apparently the only pollinating agencies. However, honey bees are desirable to insure an adequate set of fruit and under some conditions are probably indispensable.

6. Under conditions at Highmoor Farm (and these conditions are undoubtedly typical for a large part of New England) a relatively small number of early blooming horticultural varieties and "natural" apple trees are sufficient to provide pollen for a large block of self-sterile trees. These results may be due to factors peculiar to New England—viz, the presence of scattered "natural" trees in pastures and wood lots adjacent to orchards, and conditions unusually favorable for bumble bees. In general,

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[1] Papers from the Biological Laboratory, Maine Agricultural Experiment Station, No. 152.

however, it would be advisable to inter-plant varieties known to be compatible with each other although the blocks of trees need not be too small for convenience in harvesting. The addition of a number of compatible early blooming varieties would be of value and, in case only a single commercial variety is desired, the presence of a few early blooming pollen varieties scattered throughout the orchard would insure a better set of fruit.

INTRODUCTION

It is well known by horticulturists that most apple varieties are self-sterile and that for good sets of fruit provision must be made for pollen varieties and for the transmission of pollen from tree to tree. A knowledge of what varieties are inter-fertile is necessary in selecting those to be planted together or for top working certain trees in large blocks of self-sterile varieties. Most investigators have concluded that honey bees are essential for carrying pollen from one variety to another.

A list of self-sterile and self-fertile apple varieties and those known to be inter-fertile has been published in bulletin 287 of the Maine Agricultural Experiment Station. In this bulletin are included sterility relationships of varieties grown in all parts of the country, but complete records are not available for some of the most important varieties grown in Maine. In some cases the conclusions were tentative, as they were based on insufficient numbers. It is also evident from recent work that local conditions peculiar to New England may make unnecessary certain recommendations which may be applicable to other regions.

The present work on sterility relationships in apples is limited to the more important varieties grown in Maine so far as they are available at Highmoor Farm. These varieties are Ben Davis, Baldwin, Golden Russett, Rhode Island Greening, Northern Spy and McIntosh. Four of those recommended by the extension department are included in this list, but three other varieties, Delicious, Wealthy and Gravenstein were not yet available for experimental work. Some data on these varieties have been obtained from other stations.

METHODS

The usual methods of emasculating and pollinating the apple blossoms were used in 1920. The petals and anthers of the flowers were removed with forceps before the bud was open. The flowers were then protected from accidental cross pollination by covering them with paper bags. In a day or two after emasculating the bags were removed and pollen of a given variety brushed on the stigmas with a camel's hair brush. When the fruit set the paper bags were removed and replaced with cheese cloth bags. Pollen was obtained by picking buds about to open and removing the anthers. The anthers placed on a sheet of paper in a warm room soon dehisced and were then poured with the pollen into a small vial.

In 1921 another method of crossing was tried with good results and which enabled a much larger number of flowers to be worked. The method of emasculating has been used by a number of investigators working with apples, plums, and pears. The thumb nail is inserted beneath the calyx and with the aid of the fore finger the sepals, petals and anthers are removed with one operation. This method of emasculating is illustrated by the diagramatic cross section of an apple blossom shown in Figure 1.

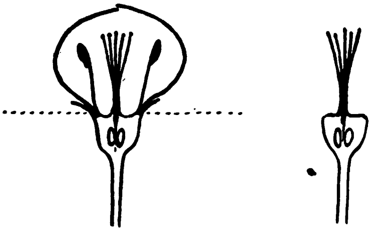

FIG. 1. Diagramatic cross section of apple blossom showing method of emasculating bud by removing anthers together with petals, stigmas, and sepals.

It has long been known that wind is not effective in cross-pollinating apple blossoms. It has also been shown by Lewis and Vincent (8) that bees and other insects rarely visit apple blossoms from which the petals have been removed. It is obvious then that it should be unnecessary to bag the emasculated blossoms to avoid accidental or uncontrolled pollination. However, all previous investigators have considered it necessary to protect the emasculated blossoms with paper bags.

For the past two years the blossoms have not been protected after emasculation in our crossing work with apples. On each tree used as the seed parent a check branch was left with 50-100 emasculated blossoms which were not protected from wind or insect pollination (except that the petals were removed by the method of emasculation and thus apparently excluded insect visitors) and which were not hand pollinated. The results from these checks are shown in Table 1.

TABLE 1.

Check on Method of Emasculating and Pollinating Apple Blossoms. Flowers Emasculated and Exposed to Insects and Wind for Pollination.

	No. of Flowers Emasculated		No. of Fruit Set	
	1921	1922	1921	1922
Golden Russett D-8	87	396	0	3
McIntosh H.O.†	69		24	
Greening F-1	71	182	0	0
Baldwin C-42	188	48	0	1
Ben Davis	132	38	0	0
Spy	84	153	4	3
Crab H.O.		202		0
Red Astrachan H.O.		132		0
McIntosh 27-1		135		2
Golden Russett D-17*		141		65

*Emasculated by removing anthers only, petals not removed.
†Tree closely surrounded by compatible pollen varieties.

It is evident that with two exceptions practically no apples set when the emasculated blossoms were dependent on wind and insect transmission of pollen. In case of the McIntosh in 1921 the relatively high set of fruit is probably due to the fact that this tree is closely surrounded by several different varieties and the branches interlock to some extent. The presence of many varieites of trees in close proximity in the "home orchard" would facilitate wind pollination. In 1922 a McIntosh tree in the Ben Davis No. 2 orchard was used and altho the McIntosh was surrounded by the compatible Ben Davis trees (set 25 feet apart) an insignificant amount of fruit set on the check branch. The high per cent of set on the Golden Russett D-17 supports the conclusions that bees visit only flowers with petals present. The 141 blossoms were emasculated by removing the anthers only and the large set of fruit shows the value of the petals in attracting insects. These check experiments show that a very small per cent of fruits develop from blossoms emasculated in the manner described even when unprotected by bags. The experimental error is probably no larger than in cases where the blossoms are protected with bags.

Under favorable conditions several thousand blossoms can be emasculated per day. Usually the blossoms were not pollinated for one or two days after emasculation, but they can be pollinated at once with good results. The flowers on a single branch were all pollinated with the same variety of pollen and each cross was given a number. A record of the number of pollinations for each cross was made with the aid of a small counting machine which was held in the hand with the pollen brush. The fruit set was determined shortly after the June drop and also at harvest time. A desirable feature of the above described method of emasculation is that all crossed apples have no calyx on the mature fruit and any open pollinated fruits that may accidentally develop are easily detected at harvest time.

At the beginning of the work the blossom clusters were not thinned but in 1921 and 1922 each cluster was thinned to one blossom or about 80 per cent of the flowers were removed. The desirability of thinning the blossoms was shown by the results of an experiment performed on a Ben Davis tree in 1920. Two branches of about equal size were selected for comparison. On one branch there were 630 flowers and 266 or 42 percent of these set fruit. The apples were thinned to 63 fruits before the June drop and 41 apples developed. The other branch bore 555 flowers and 278 or 50 percent set fruit. These apples were not thinned and 40 of them developed to maturity. The thinning of the fruit before the June drop caused a much higher percentage of fruit to develop (65.1%) than in case of no thinning (14.4%). In both cases only about 7 percent of the blossoms set fruit and yet these branches bore all that they could mature properly. This is in accord with Heinicke's (6) conclusions that a set of 3 to 7 percent will produce a normal crop. Since each cluster base develops but a single apple as a rule there is little use in working all the flowers,—especially if seeds or mature fruits are desired. When the flowers are thinned to one blossom per cluster base a much higher percentage of fruit develops to and the results are probably more uniform. The normal set,—i.e., the set obtained from open pollinated blossoms which have not been emasculated—was 6.8 percent for the Ben Davis in 1920, 7.5 percent in 1921 and 11.8 percent for 1922. Since the blossoms were thinned to one per cluster the set of apples which survive the June drop will be much higher than for unthinned clusters, and therefore the apples set per cluster under natural conditions will probably be a more accurate measure of a normal set with which to compare the set obtained on crossing. On this basis the normal set for the Ben Davis was 37 percent in 1921 and 59 percent in 1922. The use of different trees in different years undoubtedly will cause some variation as well as climatic conditions and abundance of bloom. In all cases only vigorous trees were used and with very few exceptions the trees worked carried an abundant bloom.

The crossing was done at Highmoor Farm. The trees were 25-30 years old and in good condition. The writer has been assisted in this work by H. C. McPhee, former Scientific Aid, Miss Marjorie Gooch, Assistant in Biology, and Dr. Hally J. Sax.

STERILITY RELATIONSHIPS

The results of the self- and cross-pollinating work for the past three years are shown in Table 2. The table is so arranged that the efficiency of a given variety either as a blossom parent or source of pollen can be determined readily. For instance the Baldwin is fertile with all pollen except its own and Greening, but Baldwin pollen has not given satisfactory results with any of the other varieties as seed parents. The compatibility of any combination is readily found. For instance Baldwin pollinated with Russett pollen gave 39 percent set from 102 blossoms pollinated in 1920, and in 1921 and 1922 the set was 50 percent and 13 percent respectively. This combination Baldwin x Russett is considered sufficiently fertile for practical purposes and is so indicated by the mark.* Combinations not so marked are not considered sufficiently inter-fertile to insure an adequate set of fruit for commercial purposes. The percentage of set was based on blossoms which developed into mature fruit or at least survived the June drop. In 1920 the counts were made in the autumn and any apples which fell prematurely were held in the cloth bags. In 1921-22 the counts of fruit set were made shortly after the June drop. Since some of the apples fell before maturity the percent set was somewhat less than the percent developed, but where the blossoms were thinned this difference was not great. The percent set was used as an index of fertility rather than percent developed because the latter factor would vary more with differences in tree vigor and climatic conditions.

TABLE 2.

Results of Cross- and Self-Pollination.

Seed Variety	Tree No.	Year	Number	Pollen Variety						Total Crossed
				Ben	Baldwin	Russett	Greening	Spy	McIntosh	
Ben Davis	2-26	1920	Flowers	1214	276	286	291	179	503	1535
			% Set.	0.6	0	4.	0.7	13.	9.	
	1-19	1921	Flowers	481	134	331	144	435	612	1656
			% Set.	0	7	44.	6.	62.	70	
	1-28	1922	Flowers		105	203	202	155	168	833
			% Set.		4.	*41.	3.	*39	*33	
Baldwin	C-42	1920	Flowers	417	1754	102	61	103	76	759
			% Set.	33.	0.9	39	1.	53.	38.	
	7-6	1921	Flowers	949	126	66	110	157	128	1410
			% Set.	47	0	50	1	67	54	
	C-42	1922	Flowers	48	70	127	171	27	22	395
			% Set.	*62	0	*13	6	*37	*41	
Russett	D-8	1920	Flowers	214	84	917	97	101	102	598
			% Set.	5.	1.	0	0	4.	2.	
	D-5-7	1921	Flowers	388	428	50	200		299	1315
			% Set.	57.	6.	8.	34.		46.	
	D-18	1922	Flowers	141	154	272	50	64	96	505
			% Set.	*25.	1.	0	*4	*19	*7.	
Greening		1920	Flowers	64	52	112	95		75	203
			% Set.	3.	0	0	0		1.	
	F-1-2	1921	Flowers	806	273	192	135	319	277	1867
			% Set.	5.	0	0	0	0	0	
	F-1	1922	Flowers	95	50	112	105	106	64	427
			% Set.	0.	0	0	0	0	0	
Spy	F-13	1920	Flowers	105	79	74	79	618	73	410
			% Set.	30.	6.	13.	1.	0	39.	
	A-22	1921	Flowers	60	123	85	55	99	892	1215
			% Set.	27.	0	24	7.	6	31	
	A-22	1922	Flowers	157	30	156	85	41	115	543
			% Set.	*6.	0	*7	0	0	*2	
McIntosh	HO	1920	Flowers	109	59	70	49	49	1025	336
			% Set.	18.	7.	1.	10.	22.	0.2	
	HO	1921	Flowers			120	158	134	94	407
			% Set.			2	3	75.	34‡	
	27-1	1922	Flowers	46	120	81	53	30	28	330
			% Set.	*13	17.	12	19	*7.	0	

*Classed as inter fertile.
‡Data unreliable because check branch had 85% set.

Previous investigations have shown that most apple varieties are self-sterile and that only a small percentage are completely self-fertile. The results of our studies show that all of the varieties used are almost or completely self-sterile. From a commercial standpoint it would be safe to class all of the leading apple varieties as self-sterile under Maine conditions. In certain localities the Baldwin and McIntosh are reported as partially self-fertile indicating that fertility is dependent to some extent on environmental conditions. In 1921 the McIntosh shows 34 percent set on selfing, but the check branch set 35 percent of the blossoms emasculated, indicating wind or insect pollination, so the McIntosh data for 1921 is not reliable, except perhaps for negative results. It has been suggested that pollen from other trees of the same variety might be effective but this test has previously been made with negative results. Additional work along this line was done with the Ben Davis. In 1921 a Ben Davis tree was pollinated with pollen from 9 different trees of the same variety. From 316 pollinations only 2 apples set. In 1920 the selfed blossoms were simply bagged but for the past two years all selfed flowers were hand pollinated.

Additional data on self-sterility are available for the Delicious, Wealthy, and Gravenstein. Morris (6) reports Delicious and Wealthy as self-sterile in Washington while Gravenstein is patricularly self-fertile. In California, however, the Delicious is said to be self-fertile. In Minnesota (4) Delicious and Wealthy are both self-sterile and Delicious is classed as self-sterile in Illinois (3). In Maryland (2) Wealthy is classed as self-fertile. Under Maine conditions all of these varieties are probably self-sterile.

In judging the fertility of a given combination of varieties it is necessary to consider the normal set. For the Ben Davis the normal set was 37 percent in 1921 and almost 60 percent in 1922. In 1920 it was 48 percent for Ben Davis, 36 percent for Baldwin and Russett and 55 percent for McIntosh. In general a set of approximately 30 percent in case of thinned blossoms can be considered satisfactory. On this basis more than half of the combinations given in Table 4 are inter-fertile. Ben Davis is fertile with Russett, Spy and McIntosh. Greening is slightly fertile with Ben Davis but completely sterile with all other varieties used. Spy is successfully pollinated with Ben Davis, Russett and McIntosh while McIntosh is fertile with Ben Davis, Spy and perhaps Baldwin, and Greening and Russett.

It has been generally considered that it is safe to plant almost any combination for purposes of cross-pollination, provided that they blossom at the same time. Gowen (5) has found that in 243 combinations 57 were not compatible but only about half of the infertile crosses were made in sufficient numbers to be of much value. Most of the sterile combinations include members of the Winesap group. This same group is general inter-sterile with other varieties in Washington (9) and Maryland (2). With the exception of the Winesap group most any two varieties have been found to be inter-fertile. However, no such results have been obtained in Maine, even when large numbers of blossoms have been pollinated for several years and under various climatic conditions. The Greening is completely sterile with all pollen varieties used except Ben Davis and with Ben Davis pollen it is only slightly fertile. When open pollinated the Greening set a very good crop in 1921 but it is an alternate bearing tree at Highmoor Farm and bore little fruit in 1920 and 1922. Baldwin pollen is not very compatible with any variety and is of possible economic value only in case of the McIntosh. From 30-50 percent of the Baldwin pollen is imperfect, but this factor is probably not the cause of sterility because about 50 percent of McIntosh pollen is poor and yet McIntosh is one of the best pollen varieties. Other inter-sterile combinations are found when Greening is used as the pollen parent, only the Russett and perhaps McIntosh set an appreciable amount of fruit with Greening pollen. More than 75 percent of the Greening pollen was morphologically perfect. Altogether more than a third of the combinations used are sufficiently inter-sterile to be of little practical value for purposes of cross-pollination. The greater degree of compatibility of apple varieties previously reported may be due to more favorable climatic conditions or more vigorous trees, to inadequate numbers of pollinations for conclusive results, or perhaps a relatively small set was considered adequate to class a given combination as inter-fertile. Certainly some of these factors are the cause of the larger percentage of inter-fertile combinations reported in many cases, altho varietal differences and especially the incompatibility of the Greening is partly responsible for the smaller degree of inter-fertility here reported.

In addition to the above crosses a few others have been made especially with certain common early varieties and with "natural" trees as the pollen parent. These crosses were made primarily for a special problem in pollination which will be considered later. The following combinations were found to be inter-fertile: McIntosh with Red Astrachan pollen, Ben Davis with Red Astrachan, Ben Davis with "Natural," Ben Davis with Duchess, Baldwin with Duchess, and Spy with Duchess. In Washington (9) Gravenstein is fertile with Red Astrachan, Yellow Transparent, McIntosh and Delicious pollen. Dorsey (4) reports the following combinations as inter-fertile in Minnesota: Delicious x Wealthy, Duchess x Delicious, Wealthy x Delicious, and Wealthy x Wolf River.

It is evident from a study of Table 3 that the percent of set, using the same trees and the same parental combination, may vary greatly from year to year. In the Ben Davis and Baldwin the difference is not so great as in other varieties when the method of crossing was the same, as was the case in 1921 and 1922. The Ben Davis is a regular bearer and Baldwin trees were selected which were heavily loaded with blossoms. In case of the Spy and Russett there was a light bloom on the trees used, especially on the Spy in 1922. A comparison of fruit set in 1921 and 1922 on the Spy when pollinated with McIntosh shows the result of using a tree in its "off year."

TABLE 3.

Identical Crosses on Various Branches of Individual Trees to Show Variation in Fruit Set. 1921.

	Cross No.	Flowers Poll.	Fruit Set	% Set
Baldwin 7-6 x Ben Davis 1-19	67	132	55	42
Baldwin 7-6 x Ben Davis 1-19	68	79	45	57
Baldwin 7-6 x Ben Davis 1-19	69	67	22	33
Baldwin 7-6 x Ben Davis 1-19	70	66	41	62
Baldwin 7-6 x Ben Davis 1-19	71	125	28	22
Baldwin 7-6 x Ben Davis 1-19	72	212	103	49
Ben Davis 2-19 x Spy F 13	81	46	41	90
Ben Davis 2-19 x Spy F 13	84	144	70	48
Ben Davis 2-19 x Spy F 13	85	29	20	70
Ben Davis 2-19 x Spy F 13	86	53	40	75
Ben Davis 1-20 x Spy F 13	87	138	94	68
Spy A-22 x McIntosh	123	41	8	20
Spy A-22 x McIntosh	126	47	28	60
Spy A-22 x McIntosh	130	70	18	26
Spy A-22 x McIntosh	131	98	63	64

Even on the same tree different branches pollinated with the same pollen may vary greatly in percent of set. A summary of a number of crosses on Baldwin, Ben Davis, and Spy are shown in Table 3. Each cross number represents a branch. The set on branches of Baldwin 7-6 varied from 22 to 62 percent, and similar differences are found in Ben Davis and Spy. In most cases the number of flowers worked was large enough to prevent much variation due to random sampling. These results emphasize the necessity of using large numbers of flowers and extending the work over several years.

STERILITY AS AN ORCHARD PROBLEM.

Most apple varieties are undoubtedly self-sterile and must be pollinated with pollen of a compatible variety to set good crops. The orchardists' problems are then. 1. What varieties should be planted together? 2. How close together should the different varieties be planted? 3. What provision must be made to transmit the pollen from one variety to the other? The last problem will be considered first.

Practically all horticulturists are agreed that insects, especially honey bees, are necessary to cross-pollinate apple blossoms. There is sufficient evidence to exclude the possibility of wind pollination. Alderman (1) has shown the value of honey bees in increasing the set of fruit in West Virginia. Branches of pollen varieties were placed in pails of water in a block of 16 Rome Beauty trees which are self-sterile. Six hives of bees were placed in this block. The percent of set was 12.6 percent in the plot with bees and pollen varieties, as compared with a set of 7.8 percent in a check plot. The check plot produced only half as much fruit as the plot with bees in it. A second year's test gave more set for bee plots, but the yield was practically the same as for the check plots. The value of the above experiment may well be questioned because a set of 5 to 7 percent with a normal bloom is sufficient to produce all the fruit that a tree can develop to maturity, and a set of 12.6 percent should be of little advantage in ultimate yield. The higher set in both years in the bee plots and near a Ben Davis tree is perhaps significant, but the increased number of bees and the introduction of branches of pollen varieties were apparently not influential in increasing yields.

The work of Tufts (11) with pears in California show beyond question the beneficial effect sof cross-pollination both for increased set of fruit and increased yields. Pollenizing agencies such as bees were also found necessary in almond orchards (10). Hendrickson (7) finds bees of much value in plum orchards even where the variety is self-fertile.

On the other hand Morris (9) in speaking of honey bees as cross-pollinating agents states that, "Their abundance and great activity seem to justify the conclusion that they are very important pollen conveyors, but we have not been able to find conclusive evidence that they are a necessity for successful cross-pollination . Bees travel long distances in visiting blossoms, but in many sections of Washington there have been many orchards fruiting quite satisfactorily without any tame bees known to be within several miles."

Further evidence that good crops may set even in large blocks of self-sterile varieties is available from observations at our experimental farm in 1921. The apple trees blossomed about May 15th, some varieties a day or two earlier and some a day or two later. The Ben Davis trees were in full bloom on May 19th. On May 22 a severe wind storm removed practically all of the remaining petals from all varieties except the Spy. For the Ben Davis trees the bloom period extended from May 15 to May 22. During this entire period the weather was very cold and windy, thus preventing the honey bees from traveling far from the hives. The hives of bees were kept in the small Home orchard which contains 15 or 20 different varieties of apples. During the blooming period honey bees were observed only in this Home orchard and in the Russett orchard about 200 feet away. No honey bees were observed in the Ben Davis orchard, which is about a quarter of a mile from the Home orchard during the period of bloom. Occasional bumble bees were seen in all orchards but no other insects could be found pollinating the apple blossoms. In this large block of self-sterile Ben Davis trees a satisfactory set of fruit was obtained and an unusually good crop was harvested, and yet pollination was effected only by bumble bees. Possibly a few honey bees were present but none could be seen during the time we were working in the orchard.

Closely associated with the agencies for cross-pollination is the second factor,—the interplanting of compatible varieties. It has been generally recommended that inter-fertile varieties should be planted in alternate strips of four or five rows of each variety in a block or a small percentage of pollen varieties be evenly distributed thruout the orchard.

Morris (9) work with Washington varieties shows that about 34 percent of the combinations tried were completely inter-sterile and about 18 percent were nearly inter-sterile (usually the sterile combinations included the Winesap). But even with such inter-sterility of varieties and presumably without a great mixture of varieties Morris finds that, "In all of the enquiries made in visiting the orchards and in correspondence, there has not been found an orchard containing two or more of the common commercial varieties here listed that is showing indications of failure due to self-sterility or inter-sterility of varieties."

Evidence from work at Highmoor also shows that large blocks of self-sterile trees may set a normal crop even when no compatible pollen varieties are within several hundred yards. (See p. 81, Bull. 298). Especially interesting is the behavior of the Greening trees at Highmoor. It has been shown that the Greening is almost completely self-sterile with all pollen varieties used, but the Greening trees produced good crops in 1921 and in 1919. For instance Greening F_1 produced 541 pounds of apples in 1919, no fruit in 1920 and in 1921 it produced 497 pounds, even though a considerable portion of the tree was used for crossing work. The only available compatible (?) pollen varieties were the few trees in the Home orchard about 500 feet away and a few scattered varieties and "Natural" trees at greater distances. Furthermore the pollination was effected largely if not entirely by bumble bees in 1921.

The question naturally arises: How are blocks of self-sterile varieties so thoroughly pollinated even when honey bees are unable to work? In 1922 observations were made on the activity of insects in pollinating the apple blossoms. The honey bees were very abundant and were undoubtedly the chief agencies in effecting cross-pollination. The bumble bees were next in importance. In the Ben Davis orchard they would average at least two per tree during the height of the blooming period. Although the bumble bees were not nearly so numerous as the honey bees they were much more efficient as individuals. The honey bee "worked" only about 6 flowers per minute while the bumble bee visited about 20 flowers per minute. At this rate a bumble bee could pollinate several trees per day even assuming that half of the time was spent on varieties other than those being pollinated. Among the less important blossom visitors were found species of two genera of the mining bees, *Andrena nubecula* and *Halictus paralellus,* a leaf-cutter bee *Megachile latimanus,* a species of *Nomada* and an occasional Syrphid fly.*

The bumble bee is undoubtedly an important factor in cross-pollinating apple blossoms under most Maine conditions. In cold and windy weather the bumble bee is able to work when the honey bee is not able to travel far from the hive. When orchards are in sod the bumble bees make their nests thruout the orchard. Even if the orchard is cultivated, it is usually surrounded by untilled pastures or wood lots well suited for nests of bumble bees.

The evidence indicates that pollen fertile with the Ben Davis has been supplied by comparatively few trees. The total number of Ben Davis trees, until recently, was more than 1500 in the two adjacent orchards. Recently one orchard was partially top worked with McIntosh but the latter have blossomed only during the past three years. Most of the other varieties on the farm are Baldwins which are not fertile on the Ben Davis. There are about 25 Russetts, a few Spys, several McIntosh and about 20 odd varieties, often a single branch of a variety grafted in an old tree, in the Home orchard. Altogether there were probably less than a hundred trees of varieties compatible with Ben Davis —including "Natural" trees—within a half mile radius of the Ben Davis orchards. And yet in 1914 the trees in Ben Davis orchard No. 1 averaged 175 pounds of fruit per tree which was a good crop considering the size and condition of the trees. Good crops have been obtained on an almost solid block of over 1500 self-sterile Ben Davis trees with comparatively few good pollen varieties and the latter at an average distance of a quarter of a mile from the Ben Davis orchard. How is it done?

Most of the "natural" trees and varieties in the Home orchard, such as Transcendent Crab, Red Astrachan, Duchess, and Yellow Transparent, blossom earlier than the standard commercial varieties. Naturally the bees, both honey bees and bumble bees, visit these varieties first. It is possible that the bees not only become covered with compatible pollen of early varieties, but perhaps deposit the pollen in the hives and nests so that between visits to the later blooming varieties they become contaminated with the pollen previously collected. At any rate it appears that a few early blooming varieties and natural trees can provide sufficient pollen for good sets of fruit at least under local conditions. Natural trees are especially valuable for pollen because they bloom early and abundantly and since they are seedlings the chances are that most of them will be sources of a compatible pollen supply for most commercial varieties.

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*These insects were identified by Dr. Edith Patch.

RECOMMENDATIONS

From the above results it might appear that the horticulturist has no sterility problems with apple varieties grown in Maine. However, it would be advisable to make provision for cross pollination in setting out an orchard. This does not mean that varieties be greatly mixed in planting, but blocks of compatible varieties should be planted which are not too small for efficient harvesting. Nor would it be advisable to plant blocks of inferior varieties or varieties unsuited to soil and climatic conditions simply because they are good pollen varieties. With the exception of Greening and Baldwin as a pollen parent, any two varieties considered in this bulletin can be planted together with good results so far as inter-fertility is concerned. With the exception of Spy the blossoming periods of these varieties overlap sufficiently for cross-pollination. Spy is not too late to be pollinated by the other varieties but probably would not be of much value as a source of pollen. Spy and McIntosh are especially compatible varieties and they are also excellent commercial varieties. Perhaps additional provision should be made for pollen varieties for McIntosh. As a rule most orchardists will want a few early or odd varieties for home use or a local market. A mixture of these varieties, together with a few hives of bees, should be of value in insuring adequate pollination. The Red Astrachan is exceptionally fertile with McIntosh and Duchess is a good pollen variety with Spy and Delicious. The planting of compatible, early blooming varieties at the rate of several per acre would be of considerable value if large blocks of a single commercial variety are set.

In an old orchard of a single variety that is bearing poor crops it is not advisable to top work extensively with scions from pollen varieties until other factors have been considered. Perhaps an application of several pounds of nitrate of soda per tree before blossoming time would prevent an excessive drop of fruit. The need of better pollination could easily be tested by hand-pollinating several hundred flowers as described in this bulletin with a variety known to be compatible and comparing the set with an equal number of flowers which have been pollinated by insects. In both cases blossoms should be thinned to one per cluster. The presence of honey bees undoubtedly increases the set of blossoms and in case other insects were not abundant the honey bees would be necessary to insure an adequate crop.

LITERATURE CITED.

1. Alderman, W. H., 1917. Experimental work on self-sterility of the apple. Proc. Amer. Soc. Hort. Sci. p. 94-101.
2. Auchter, E. C., 1921. Apple pollen and pollination studies in Maryland. Proc. Amer. Soc. Hort. Sci. p. 51-80.
3. Crandall, C. S., 1921. Results from Self-pollination of apple flowers. Proc. Amer. Soc. Hort. Sci. p. 95-100.
4. Dorsey, M. J., 1921. The set of fruit in apple crosses. Proc. Amer. Soc. Hort. Sci. p. 82-94.
5. Gowen, J. W., 1920. Self-sterility and cross sterility in the apple. Maine Agr. Exp. Sta. Bul. 287, p. 61-88.
6. Heinicke, A. J., 1917. Factors influencing the abscission of flowers and partially developed fruits of the apple *(Pyrus malus* L.) Cornell Agr. Exp. Sta. Bul. 393, p. 43-112.
7. Hendrickson, A. H., 1919. Plum pollination. Cal. Agr. Exp. Sta. Bul. 310, p. 3-28.
8. Lewis, C. I., and Vincent, C. C., 1909. Pollination of the apple. Ore. Agr. Exp. Sta. Bul. 104, p. 3-40.
9. Morris, O. M., 1921. Studies in apple pollination. Wash. Agr. Exp. Sta. Bul. 163, p. 4-32.
10. Tufts, W. P., 1919. Almond pollination. Cal. Agr. Exp. Sta., Bul. 306, p. 337-366.
11. ——————, 1919. Pollination of the Bartlett pear. Cal. Agr. Exp. Sta. Bul. 307, p. 369-390.

BULLETIN 308

THE BLUEBERRY MAGGOT

In Washington County[1]

By Edith M. Patch and William Colcord Woods.

Introduction.

Perhaps as unique and interesting an ecological community as may be encountered in the State of Maine is presented by the blueberry barrens of Washington County which comprise a vast area of unforested land in the eastern part of the state, extending roughly from Cherryfield in the west to Machias in the east and including more especially Deblois and the townships numbered 16, 17, 18, 19, 24 and 25. How the barrens originated is a matter of dispute and there are several theories as to their beginning, but at any rate this fact is clear: in this section of the country wherever the forests are removed and more especially when they are destroyed by fire, blueberry bushes tend to spring up in large numbers. The barrens or "plains" consist of great stretches of mostly level or slightly rolling land more or less broken up by lakes and swamps. These together with old fields and pastures and newly cleared woodlands comprise the regions where blueberries are harvested.

Climatic conditions such as characterize the whole coast of Maine prevail here: relatively short summers, which on the barrens are very hot, and long winters during which, however, the plants are usually well protected by snow. The average annual rainfall is 45 inches; typically there is a heavy rainfall followed by a dry period in June, a condition which seems to be favorable to the growth of blueberry bushes. When tested the soil, which is a mixture of sand, gravel and loam, is found to give an acid reaction.

Locally the mountain-cranberry (*Vaccinium Vitis-Idaea* L. var. *minus* Lodd) forms a dense cover over the ground, especially along the sides of little ravines. Huckleberries (*Gaylussacia baccata* (Wang) C. Koch) and chokeberries (*Pyrus melanocarpa* (Michx.) Willd.) are in places very plentiful, while the other more characteristic plants associated with the blueberries are the sheep-laurel (*Kalmia angustifolia* L.), sweet-fern (*Myrica asplenifolia* L.), and young gray birches (*Betula populifolia* Marsh). Less characteristic but common on some parts of the barrens are the alder (*Alnus incana* (L.) Moench), meadow-sweet (*Spiraea latifolia* Borkh) and several species of aster and goldenrod.

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[1] Papers from the Maine Agricultural Experiment Station: Entomology No. 110. This bulletin is in part compiled from Bulletin 244 from this Experiment Station and in part from various unpublished reports by William Colcord Woods, and Edith M. Patch

Three species of blueberry (all of the so-called low-bush type) occur on the barrens.[2] These are in order of abundance the low sweet blueberry (*Vaccinium pennsylvanicum* Lam.), the sour-top or velvet-leaf blueberry (*V. canadense* Kalm.) and the late low blueberry (*V. vacillans* Kalm.). Of these the first is the most common, the most desirable, and the one chiefly gathered for canning. Growers often speak of black and of white blueberries. The black blueberries are botanically a form of *V. pennsylvanicum* Lam., namely var. *nigrum* Wood. These are not uncommon, and are in every way desirable. The white blueberries are rare; they may be either *V. pennsylvanicum* Lam. forma *leucocarpum* Deane or *V. canadense* Kalm. forma *chiococcum* Deane.

In eastern Maine, the blueberry is in flower about the middle of May, and on the barrens the fruit begins to ripen quite generally by the end of July. During the berry season which lasts from early August until into September, the pickers move out to the barrens with their families, and live in shacks or tents, so that the plains appear not unlike an army encampment.

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[2] Blueberries are widely distributed elsewhere throughout the state, but for the most part they grow only in pastures and waste land, and until recently there has been no real blueberry industry outside of Washington County, although the fresh fruit has been, and is, gathered quite generally for local use. Of late years the packing of blueberries has been more widespread, and considerable care has been paid to the growth of this crop in other parts of the state, especially near Rockland and Portland. As on the barrens, it is the low bush varieties which are gathered for canning, especially *V. pennsylvanicum*. Two species of high bush blueberries, *V. corymbosum* L. and *V. atrococcum* (Gray) Heller occur in the state, usually in moister localities, but so far as the writers know, are comparatively little used.

Although the berries, which are picked with a rake similar to that used for gathering cranberries. are under favorable conditions as firm and clean as hand picked fruit, usually more or less foreign matter is collected in the process of raking. It is a common though not a universal practice to winnow the berries in the field for the purpose of eliminating such leaves and other foreign material as can be blown out by the hand-power winnowing machine. The fruit is then poured into wooden boxes, and taken to the canneries. Before it is packed, it is subjected to a more thorough winnowing in a power-driven machine.

Although the blueberry stands transportation well, comparatively little of the fruit is shipped fresh on account of the high rates charged, and most of the berries are sold directly to the canneries and to the local markets. Washington County with its 13 canneries is the principal home of the blueberry industry in this state. Other canneries for blueberries located outside of this county are in Amherst, Belfast, Bucksport, Castine, Sargentville, Sedgwick, Thomaston and Waldoboro.

In 1886 when the first attempt was made to pack blueberries, 5,000 bushels were put up; in 1912, this had increased to some 90,000 bushels; while in 1922, 184,450 bushels were handled at the factories, and the value of the canned product was estimated at $1,000,000.

It has been the common practice to burn the blueberry bushes every third year, although occasionally the land is allowed to lie unburned for as many as 5 years or even longer. As a rule. each owner divides his land into 3 approximately equal lots which are burned in rotation, one each year. No berries are produced on the "new burn" (by which is meant the first year's growth of bushes after burning) but the second year the bushes bear very heavily, and somewhat less heavily in succeeding years, the reason being that the fruit is produced on the new wood developed during the preceding year. All the stems above ground and leaves are destroyed in the burning and only the tangled mass of roots remains, so that there is a very vigorous growth during the first year, but decidedly less the second year as so much energy must be expended in developing the berries. The fires are set on a clear morning in the spring and sweep across the barrens all day but are checked by the heavy dews in the evening.

The advantages of such burning are apparent both as to pruning the blueberry bushes and restraining of tree and weed-bushes which would otherwise shade the plains. The effect of continued burning on the necessary acidity of the soil, however, is a matter which should be investigated with reference to cultural practices in the future.

NOTES ON THE BLUEBERRY MAGGOT.[3]

A long list of insects which attack either the foliage or the fruit of the blueberry might be drawn up, but at least in Washington County, Maine, only one is of serious economic importance. This is the blueberry maggot known technically as *Rhagoletis pomonella* Walsh as it is considered to be a biological strain of the well-known apple-maggot, or railroad worm, though characterized by a smaller size, shyer behavior and different food habits.

Like the other Diptera or two-winged flies, the order to which the blueberry maggot belongs, there are four stages in the life cycle of this insect, the egg, the larva, the pupa, and the adult or imago. In this last stage, the insect is a little dark fly, somewhat smaller than the common house fly, with black bands on the wings. These flies, which may be found in the field from mid-July until frost, deposit eggs in the ripe fruit. In a few days these eggs hatch into larvae, commonly known as maggots which live in the fruit about two weeks, causing "wormy" blueberries. When full fed the maggot leaves the berry and burrowing into the soil changes into a pupa, enclosed in a barrel shaped covering, the puparium, which is really the last larval skin. The winter is passed in this condition, but in the following summer the pupa transforms into the adult or fly. This generation of flies deposits eggs in the berries and thus the life cycle is repeated once and only once each year.

THE ADULT OR FLY.

Although the total number of individual flies on the whole extent of the barrens must be very large they are nowhere easy to find and the capture of 20 or so in a day calls for 8 or 9 continuous hours on the plains, and even then usually one sees but 10 or 12. It is possible that when their habits are better known, it will be easier to find them.

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[3] These notes are compiled from the records of four seasons' work on the barrens. The observations during 1913, 1914, 1915 were made in the vicinity of Cherryfield by the junior author. (See Bulletin 244, Maine Agricultural Experiment Station). In 1922 different localities from Harrington to Jonesboro were visited by both authors.

In 1913 two trips were made to the plains, the first on July 30 and the second on August 14. Adults were present on both dates. Rather more data are available for 1914. On July 2 the first visit was made to the plains for that year. No flies apparently had yet emerged. An attempt to dig out puparia was partially successful for a few were obtained, but this is a difficult procedure partly because, as the puparia are so scattered, much soil must be sifted in order to find only a few, and partly because the tangled mass of roots and underground stems renders digging very difficult. No flies emerged from any of these puparia and subsequent examination showed that all were dead, probably because they were dug on "new burn." On July 20 a few adult flies were captured and it seems fair to assume that they began to emerge about the middle of the month. They were observed during August and as late as September 10.

It has not yet been ascertained how long after emerging, the blueberry fly lives before she deposits eggs.[4]

There is one very striking difference in the behavior of the adult flies of the apple maggot and those of the blueberry maggot. Whereas on the apple the flies are rather sluggish, so that it is easy to watch oviposition in the field, on the blueberry they are very alert and shy, and oviposition in the field has not yet been observed. The adults suddenly appear on the berries seemingly as if they had just sprung into existence, and are so active that it is no easy task to take them captive, a decided contrast to the larger, comparatively sluggish apple flies.

The adults are restless in confinement and they seem loath to oviposit in captivity but the junior writer has witnessed the process once. Then it took place just as has been described for the apple maggot. The fly walked over the surface of the berry and finally stopped, head downward. Lifting her abdomen, she thrust out her ovipositor and made a slit at an angle of 45 degrees in which she deposited a single egg just below the surface. This occupied about 2 minutes. Unfortunately this egg did not develop. Eggs in a number of instances, which have been found in ripe berries in the field, hatched within 24 hours after they were collected but it was not known how long before they had been laid. It is thought, however, that the egg period in the blueberry does not exceed 2 or 3 days.

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[4] Doctor Illingworth (Cornell Exp. Sta. Bul. 324, p. 143) records the time as 24 days for specimens of *Rhagoletis pomonella* bred from apple. In his bulletin is published a detailed account, with figures, of the development of the eggs in the female.

At all events these data are sufficient to show that in the case of the blueberry maggot as with the apple maggot, the egg is deposited directly in the fruit and not in the blossom; for the adults do not emerge until fully 6 weeks after the bushes have flowered.

THE LARVA OR MAGGOT.

The observations of four different years indicate that a few maggots can be found early in August but they are at first so small that they readily escape detection. From the time the maggots first appear they become for a while increasingly abundant. This is indicated in counts made in 1922. On August 12, an examination was made of 1000 berries taken from a location within an area of rather heavy infestation. They were found to be 3.5% maggoty. Four days later an examination of 500 berries from the same place gave a count of 10.4% maggoty fruit. Similar counts in a second locality nearby, but subject to heavier infestation, showed a 6.9% infestation on August 12 and a 22.0% infestation on August 16.

During the days August 12-16, both dates inclusive, 12,000 berries in 500 and 1000-berry lots from different localities were opened and examined by the writers. During the first week in September, 11,000 berries from the same localities were opened and examined by the senior author and a field assistant. The percentage of berries containing maggots was shown by these counts to be higher on August 16 than in the first week in September. This does not, of course, mean that fruit after the first of September is in better condition than that picked before the middle of August, for soon after the middle of August there is an increasing number of berries that, judging from appearances, *had been* infested and from which the full-fed maggots had dropped. This season's investigations would indicate that while the maggots reached their maximum numbers soon after the middle of August, they showed up more conspicuously after that date than before. The reasons for this seem to be the higher percentage of very small (young) maggots coupled with the greater firmness of the fruit early in the season, as over against the higher percentage of larger (halfgrown to full-fed) maggots coupled with the softer over-ripe berries later on. Although maggots were found in berries both in the general vicinity of Harrington and Jonesboro in August and September, the specific areas of infestation seemed characterized by localization. That is there were places near both these towns where the fruit was practically free from infestation; one count of 1000 berries near the former town taken August 14 registering only 0.5% maggoty and one count of 1000 berries near the latter town August 15 registering perfect fruit. On these same dates, not far from the same places centers of infestation were found where the fruit registered 7.6% maggoty for the former town and 6.7% maggoty for the latter. It should be said that in both cases the clean fruit was from "improved" land (regularly burned and with weed-bushes kept down) while the other count was taken from land not receiving the same care. While it should be emphasized that in general it was found that the fruit on the more "improved" land was conspicuously less subject to infestation than fruit from land not receiving much attention, the idea should not be conveyed that the percentage of infestation was high in all the neglected land for some thousand-berry counts of perfect fruit were made in pastures where the "weed-bushes" (birches etc.) were more than shoulder high.

Records taken in the field for four seasons show that by the middle of August maggots are present in all stages of growth from those just hatched to those which are full-fed and ready to leave the berries and pupate. Newly hatched maggots have been found as early as July 30 but only very young maggots are present the first week in August; and by September 10 chiefly maggots in their later stages of growth are found, there being comparatively few very young ones at this time. On August 18, 1922, August 21, 1914 and August 22, 1913 puparia were obtained, showing that by that time some of the insects had already completed their maggot-life within the berry and had entered the next or pupal stage. In 1914 a few larvae were reared under such conditions as to make sure the exact number of days passed in the berry. One maggot which hatched August 18, was in the third instar on August 24, and formed its puparium on September 2. Two which hatched August 26, were in the last instar on September 2, were apparently full grown September 7, left their berries September 8, and formed puparia September 9. One which hatched August 28, was in the second instar September 2, and in the last instar September 8; the puparium was formed on September 14. One which was in the second instar on August 26, was in the last instar on September 2 and formed its puparium on September 7. These records indicate that the maggot spends on the average about 14 days in the berry and that the period spent during the last instar is nearly as long as the time of the two preceding instars together. The maggot attains its full growth in one berry, which it leaves by an irregular and jagged exit-hole. Only one maggot is found in a berry under natural conditions. Often the fruit falls off shortly before the maggot becomes full-fed, but it is not at all uncommon for it to remain on the bush after the maggot has entered the soil. In such cases the maggot doubtless works its way to the surface of the berry and then drops to the ground.

When ready to form their puparia, the larvae enter the soil which is of a sandy character on the barrens, but probably do not penetrate to a depth of much more than an inch. Under laboratory conditions they barely bury themselves beneath the surface in most cases. As is characteristic of this group of flies, pupation takes place within the last larval skin which is not molted but shrinks up and hardens, turning a light yellowish brown. Invariably the puparia are formed within 2 days after leaving the berry and usually within one. Transformation to the pupal stage takes place within 7 days after the puparia have been formed; usually about the fifth day.

HOST-PLANTS.

The blueberry fly has been bred at this Experiment Station from the three species of low blueberries, *(Vaccinium pennsylvanicum, V. canadense* and *V. vacillans.)* Mr. O'Kane[5] has recorded it from high bush blueberries, *(V. corymbosum).* This species has not been recorded at work in the mountain cranberry,

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[5] N. H. Exp. Sta. Bul. 171, p. 18.

(V. Vitis-Idaea var. *minus,)* locally common on the plains. The huckleberry, *(Gaylussacia baccata,)* also common on the barrens, is subject to attack late in the season. The maggots do not seem to make much if any use of huckleberries on the barrens in August but when the blueberries are becoming scarce in early September, then the huckleberries are quite generally infested. Twice before, this insect has been reared from huckleberries *(Gaylussacia* sp.) : once in Connecticut by Doctor Britton (Rpt. Conn. Sta. 1905, p. 200) ; and once in New Jersey by Doctor Smith (Insects of N. J., 1909, p. 802). Apparently this same race has been bred from snowberry *(Symphoricarpus racemosus* Michx.) in British Columbia by Downes, who confirms the writer's observations on the behavior of the adults. It is known from California also. (Can. ent. 1919 v. 51 :2-4).

Chokeberry *(Pyrus melanocarpa),* is locally abundant on the plains but a careful search has failed to reveal any maggots in this fruit. The junior writer did succeed in making transfers and very small larvae removed from huckleberries and blueberries attained their growth and formed puparia when placed in chokeberries.

For one very peculiar fact of distribution it is hard to offer a satisfactory explanation. In Maine, although as an apple pest *Rhagoletis pomonella* is widely distributed throughout the state, and although blueberries are found commonly everywhere in the state, the blueberry maggot has been found so far in economic numbers only in the Washington County area. It has been found in all parts of the county where berries have been examined. Maggots were also taken in berries collected in West Rockport, the season of 1922. No maggots have been found in berries examined in previous years from other parts of the state (Orono and vicinity, Ellsworth, Mount Desert, Searsport, Auburn, Kineo, and the Katahdin region) nor this year in berries gathered in Gray and Brunswick in Cumberland County.

As has been stated, the flies bred from blueberries are so much smaller than those bred from apples that they can be distinguished at a glance. Although the apple maggot was very troublesome in the orchards of Cherryfield in 1914 neither there nor elsewhere were any flies that were subnormal in size observed on the apples. These observations are in accord with those made by Mr. W. C. O'Kane in New Hampshire.

Several attempts were made, both in the laboratory and in the field to induce the fly of the apple maggot to lay eggs in blueberries; but without success. A large cage was placed over a healthy blueberry plant, and about 20 adult flies just captured on apple were introduced, but they refused to oviposit. This was done twice in the field and on a smaller scale several times in the laboratory and insectary, always with negative results. At various times during the summer some 20 or more half-grown blueberry maggots were introduced into apples of various kinds, being inserted beneath the skin in such a way that they could burrow into the pulp before drying up, but not a single one developed sufficiently to form a puparium. Likewise flies taken on blueberries did not oviposit in apples, but as they also showed so much reluctance in the laboratory to oviposit at all, even in blueberries, one should not lay too much stress on this point.

At any rate the writers are inclined very strongly to the belief that biologically at least there are two distinct strains or races of *Rhagoletis pomonella* Walsh, the one breeding in the apple and related fruits and the other in smaller fruits such as the blueberry and huckleberry. In so far as *Rhagoletis* occurs in Maine the form on the apple and the form on the blueberry seem to be independent. The "oldest inhabitant" of the barrens cannot remember a time when there were not maggots in the blueberries, while the introduction and spread of the apple maggot in the state is a matter of record and is discussed by Professor Harvey in the Annual Report of this Experiment Station for 1889 and subsequent years. In Maine the blueberry maggot apparently did not migrate to the apple nor *vice versa* and the two races have lived on independently side by side.

NATURAL ENEMIES.

A parasite[6] belonging to the same order of insects as the wasps preys upon the maggots and no doubt plays its part in the "balance of nature" relative to the blueberry maggot. This insect was bred in considerable numbers from puparia obtained from blueberries in 1913. Under laboratory conditions the adults emerged at various times between February 25, and April 21,

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[6] A braconid parasite, *Opius melleus* Gahan (of which *Biosteres rhagoletis* Richmond is a synonym).

1914, from the pupae of the blueberry maggot. Specimens of this species were collected on the blueberry barrens of Washington County during the summer of 1914. Adults were observed quite commonly on the barrens hovering about the blueberry bushes on August 26, 1915. They were rather slow moving and not very shy. In one case fortunately the process of oviposition was witnessed by the junior writer. The long ovipositor was thrust its full length into the berry. Judging from the date of pupation the maggot was very young when the egg of the parasite was deposited in it. It is, therefore, a larval parasite although the parasitized larva grows normally and forms its puparium. In the field the parasite doubtless passes the winter protected within the puparium of the host and does not emerge until midsummer or later.

Insect-eating birds are present on the barrens and undoubtedly capture many of the flies that would otherwise live to deposit eggs.

CONTROL MEASURES WITH REFERENCE TO THE CANNING INDUSTRY.

During the season of 1922, 35 collections of blueberries were made in different parts of the blueberry plains of Washington County by the writers and a field assistant. Altogether we gathered, broke open (one at a time with our fingers) and examined 23,000 berries. The range and locality and conditions and percentage of infestation were recorded; but the items which form a basis for this discussion are of a local character and can be omitted from a general account. It should be emphasized, moreover, that the territory is too large and varied and the problem too complex to be solved by four seasons' observations and the examination of 35 collections of fruit. The economic phases of the situation merit detailed study and experimental work. The suggestions which follow are the best we can do at present but they lay no claim to adequacy.

1. *Early canning.* While in uninfested localities there is no entomological reason for haste in picking, it seems safe to draw the conclusion that berries from badly infested areas should be canned by the middle of August if evidence of the maggot is to be excluded from the pack. If some method of eliminating the green fruit at the factory could be devised, thus doing away with

the only objection to early canning, the advantage would be twofold, insuring maggot-free berries and at the same time fruit of better quality than the later product; because in waiting for the last fruit of the cluster to ripen, (smaller and poorer than the rest) the largest and best of the fruit gets past its prime and in many cases even drops from the bushes and is lost altogether.

2. *Speed in handling the fruit.* In addition to the urge for early picking, with its double advantage of firm and maggot-free fruit, emphasis should also be put upon speed in handling the berries after they are picked. The use of the automobile for carrying the fruit from field to factory, and the practice in certain canneries, at least, of running an occasional night shift during the height of the season might indicate that a plea for speed is superfluous. There is, however, a valid entomogolical reason for emphasizing this point as may be illustrated by the following data. In one place, 1000 berries were gathered, 500 of these were examined at once and found to be 6.2% maggoty. The other 500 were stored for 48 hours when they were examined and found to be 7.0% maggoty. This indicated that in approximately one berry out of every hundred a maggot, either unhatched or so small as to escape detection on the first day, could be found showing up two days later.

So far the discussion has been confined to considerations relative to excluding the maggot from the pack. If we turn now to the possibilities of combative measures directed against the blueberry maggot there would seem to be several methods of attack.

3. *The destruction of the maggot in the fruit.* From a purely remedial-measures standpoint, of course, the more maggoty berries gathered and cooked, the better. The logical corrilary to this proposition is a program of clean picking and late picking. It is obvious that if the raking could be continued until September 1 or later, and the fruit cooked, the numbers of maggots in the field would be reduced and, as a consequence, the next season's egg-laying flies would be substantially fewer.

4. *The destruction of the pupae in the soil.* The full-fed maggots leave the fruit and pupate in the ground near the surface. In this dormant condition, they pass the winter. It was found several years ago that pupae collected from burned ground did not emerge. Though more extended experimental work

would be advisable in this connection, there would seem to be no more effective weapon to direct against this insect than fire—a weapon successfully used against hibernating meadow insects under certain conditions. The fact that, in general, even in the vicinity of badly infested areas, the better "improved" blueberry fields showed a low percentage of infestation, is probably largely due to the present practice of burning over the land. *If we could consider, in this connection, the entomological phase alone,* especial stress would be placed on this practice and its extension urged to a biennial burning of waste land (where such exists) immediately adjoining the "improved" fields. We do not, however, feel justified in urging more extensive burning than is now practiced until there are definite data as to its effects on the soil from the standpoint of the blueberry.

5. *Preventing the flies from depositing eggs.* In addition to the destruction of the pupae in the soil, the practice of burning serves a second entomological purpose. The "new-burn" does not fruit and such an area is of necessity free from maggots in the summer, free from hibernating pupae during the winter, and free from emerging flies the following summer. Fortunately similar results can be obtained so far as securing an area without fruit for a season, by cutting the bushes, or by ploughing them under. Both of these cultural methods, we are told, are practiced to a limited extent, and are to be commended as combative treatment in the case of the maggot, whatever their status may be with reference to blueberry horticulture in general.

6. *Clean picking.* In so far as is practicable, emphasis might well be placed on leaving as little ungathered fruit as possible. Bushes in or bordering a field which are so situated that they cannot be raked would better be cut down with other weed-bushes than left to breed maggots. The same may be said with reference to areas occupied by "sour-top" or "velvet-leaf" blueberry *(Vaccinium canadense),* and huckleberry *(Gaylussacia baccata),* both of which species are liable to infestation and, if left to bear ungathered fruit, become breeding places for the maggots.

7. *The destruction, where practicable, of wind breaks.* As has been indicated in the body of the bulletin, certain areas are much more badly infested than others near at hand. There are reasons to think that wind exposure may determine such local abundance of the maggots. Wherever especially heavy infesta-

tions so far have been noted, there have been bushes or rocks which would give shelter to the fly from the wind while she is ovipositing. Although in places, uninfested fruit was found in neglected pastures, there was in general a conspicuous coincidence of low percentage of infestation with low percentage of sheltering weed-bushes. It may be found that the areas which are wind swept are, because of that, better protected from visits by the egg-laying fly.

8. *The destruction of waste at the cannery.* Infested fruit hauled to the factory and refused as unfit to pack should not be dumped in such a way as to give the maggots a chance to develop and start a center of infestation. The disposal of such material should be provided for. It might be burned, cooked, or buried according to local convenience. On general principles, too, it would probably be safer to dispose of the waste at the sorting tables and the factory winnowings by burning or burying, or otherwise treating it so as to destroy maggots if they are present in such refuse. Spraying with kerosene preparations or heavier oils might be a feasible treatment.

CONCLUDING COMMENT.

This report on the blueberry industry, entomologically considered, records our acquaintance with the situation so far as it extends at present. It should, of course, be interpreted as an initial statement for the problem is too big to be conclusively handled in the time and with the facilities that have been available, so far.

Indeed some of the factors of its bigness are increasingly more apparent; for the past season has again demonstrated that the adage, "no man lives by himself alone," applies to the entomologist with particular fitness. For if we urge earlier picking, an efficiency expert must needs devise some method of eliminating green berries from the pack. If we urge continuous and late picking, a market must be provided for the late-season product. We cannot unreservedly recommend burning if the chemist denounces the practice in the interests of soil acidity; or cutting or ploughing, if such methods do not meet the approval of the horticulturalist.

As a matter of fact, the problem is big, partly because it, like all other agricultural projects, is a complex, calling for cooperative study by biologist, chemist, entomologist, horticulturalist, and plant pathologist.[7]

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[7] The latter being indicated by the discovery, on one of the best grounds, of blueberry rust *(Calyptospora columnaris)* present to an injurious, if not to an alarming, extent.

FIGURE 2.

Fly *(Rhagoletis pomonella).* Greatly enlarged.

A. Female fly with ovipositor extended.
B. Male fly.
C. Tip of abdomen of female fly showing the ovipositor with which the fly inserts the egg into the fruit.
D. Eggs. These are laid directly in the fruit and hatch in a short time.
E. Maggot, which hatches from the egg and attains its full growth in the fruit.
F. Pupa. After the maggot becomes full grown it drops from the fruit and pupates near the surface of the soil. It remains in this stage until the next summer when the adult fly emerges from the puparium.

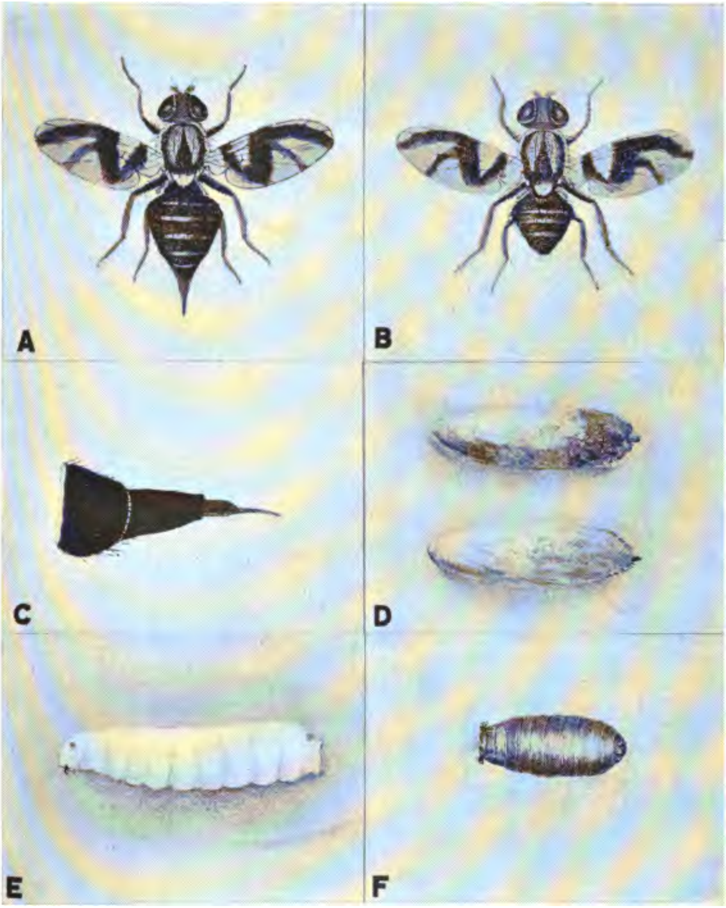

FIG. 2.

BULLETIN 309

ABSTRACTS OF PAPERS PUBLISHED BY THE STATION IN 1922 BUT NOT INCLUDED IN THE BULLETINS.

A complete list of all the publications issued by and from the Station in 1922 is given on page ix of the introduction to this Report. The following pages contain abstracts of the papers issued during the year that are not included in the Bulletins or Official Inspections for the year.

STERILITY IN WHEAT HYBRIDS.

II. CHROMOSOME BEHAVIOR IN PARTIALLY STERILE HYBRIDS.*

The chromosome number and behavior has been determined for the cultural species of Triticum and for certain partially sterile hybrids.

The gametic chromosome number is 7 for *T. monococcum;* 14 for the Emmer group, consisting of *T. dicoccum, T. durum, T. polonicum,* and *T. turgidum;* and 21 for the Vulgare group, consisting of *T. vulgare, T. compactum* and *T. Spelta.* Rye *(Secale cereale)* has 7 gametic chromosomes.

In the F_1 hybrid of *T. monococcum* x *T. turgidum* 7 chromosomes are contributed by one parent and 14 by the other parent. In the heterotypic division of the pollen mother cells there are 7 bivalents and 7 single chromosomes. The 7 bivalents divide normally, but the 7 univalents pass at random to either pole without dividing. In the homoeotypic division there are usually about 10 or 11 chromosomes which apparently divide normally in most cases. Tetrads and one-nucleate pollen grains appear to be normal, but very few normal mature pollen grains are formed.

In F_1 hybrids between members of the Emmer group and members of the Vulgare group, 14 chromosomes are contributed by one parent and 21 by the other parent. In the first meiotic division there are 14 bivalent and 7 univalent chromosomes. The bivalents divide normally, but the univalents do not become oriented on the equatorial plate until the bivalents have divided. The

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*This is an abstract of a paper by Karl Sax having the same title and published in Genetics, Vol. 7, pp. 513-552, November, 1922.

7 lagging univalents divide equationally and 7 chromosomes pass to each pole. In the homoetypic division the original members of the bivalents divide normally, but the remaining 7 chromosomes pass at random to either pole without dividing. As a result the chromosome number of the microspores varies from 14 to 21. The tetrads and one-nucleate pollen grains appear to be normal, but in later stages about 20 percent of the pollen grains are obviously imperfect and undoubtedly a larger percentage is non-functional.

The size of the pollen grains is closely correlation with the chromosome number in the various species of wheat.

The pollen grains of fertile species hybrids are more variable than the pollen grains of the parental species, due to various degrees of compatibility of the combinations of non-homologous chromosomes in the gametophtic generation. In partially sterile hybrids where the parental species differ in chromosome number, the pollen grains are extremely variable, due to difference in chromosome number and to more or less compatible chromosome combinations.

The sterility in the hybrids described can be accounted for on a hypothesis involving, (1) the numerical or unbalanced relations of the chromosomes resulting from the irregular meiotic divisions, and (2) the specific interrelations of the parental chromosomes. In the numerical relations the development of gametes varies as the chromosome number approaches the normal gametic number (7, 14 or 21). It is assumed that the greater the gametic chromosome number the greater can be the deviation from the normal number. The specific relations of the gametic chromosomes will depend on the extent that chromosomes from one parent can be substituted for those of the other parent. Gametic perfection will vary as the chromosome constitution approaches that of the parental forms. The 7 univalents in the Emmer-Vulgare F_1 hybrids presumably carry most of the factors which differentiate the Vulgare characters from the Emmer characters.

This hypothesis will explain (1) the differences in sterility of the various species hybrids, (2) the partial association of the original parental characters in the F_2 segregates, (3) the absence of varieties or species with intermediate chromosome numbers, and (4) the difficulty in obtaining homozygous segregates combining the desirable characters of the parental species in partially sterile wheat hybrids.

In all cases the F_1 plants are unusually vigorous and sterility is not due to poor vegetative development, but is caused by the formation of non-functional gametes. Sterility in F_2 segregates may be greater than in F_1 individuals due, not to greater gametic sterility *per se,* but to a combination of weak somatic development and gametic sterility.

There is a high degree of correlation between chromosome numbers and adaptability and economic value of wheat species. The species with 7 chromosomes are of no economic value and are found only in hot, tropical regions. Those with 14 chromosmes are of some economic value though none of these varieties are of value for making light bread. These species are for the most part spring wheats and are not suitable for cold climates. They are mostly from the regions around the Mediterranean. The species of wheat with 21 chromosomes are the ones of greatest economic value and are the only ones containing varieties suitable for the making of light bread. Species of this group are found all over the world where wheat can be grown and diverse regions in regard to climatic conditions. Since there is so high a degree of relationship between economic value and chromosome numbers in the species of wheat it might be of value to try to increase the chromosome numbers by artificial means. This has been done in a limited way in certain other species.

STERILITY IN WHEAT HYBRIDS.

III. Endosperm Development and F_2 Sterility.*

Crosses between strains of wheat which differ in chromosome number result in small, wrinkled grain and more or less sterility in F_1. Since poorly developed F_1 endosperms are associated with sterility and unusual vegetative vigor of the F_1 plant, a high degree of correlation would be expected between F_2 endosperm development and sterility and vegetative development of F_2 plants. An analysis of the data obtained from a cross of Kubanka x Bluestem indicates, however, that there is little or no correlation between F_2 endosperm development and F_2 sterility or vegetative development. Apparently the results of the peculiar chromosome relationships in endosperm formation do not indicate the nature of the chromosome relations of the accompanying embryo.

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*This is an abstract from a paper by Karl Sax having the same title and published in Genetics, Vol. 7, pp. 553-558, November, 1922.

AROOSTOOK POTATO INSECTS.*

Since aphids have been found to transfer potato mosaic and leaf roll (Bulletins 292, 297, and 303, Me. Agr. Exp. Sta.), and certain other insects with piercing and sucking mouthparts are being viewed with suspicion, a list of Hemiptera frequenting potato vines may prove suggestive to persons interested in experimental work with disease transference. The following insects were collected from potato at Presque Isle, Maine in 1921. While certain of them may have been resting on potato vines by chance, most of them were common enough to be taken repeatedly though none, except *Lygus pratensis,* were abundant enough the past season, to assume significant economic importance. *Cosmopepla carnifex, Canthophorus cinctus, Adelphocoris rapidus, Poecilocapsus lineatus, Lygus pratensis, Philaenus spumarius, Philaenus lineatus, Clastoptera proteus, Ceresa basalis, Platymetopius acutus, Acocephalus nervosus (striatus), Phlepsius apertus, Graphocephala coccinea, Agallia sanguinolenta.*

METEOROLOGICAL OBSERVATIONS.

For many years the meteorological apparatus was located in the Experiment Station building and the observations were made by members of the Station Staff. June 1, 1911, the meteorological apparatus was removed to Wingate Hall and the observations are in charge of Dr. James S. Stevens, professor of physics in the University of Maine.

In September, 1914, the meteorological apparatus was moved to Aubert Hall, the present headquarters of the physics department.

The instruments used are at Lat. 44° 54′ 2″ N. Lon. 64° 40′ 5″ W. Elevation 135 feet.

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*This is an abstract from a paper by Edith M. Patch, having the same title and published in Journ. Econ. Entomology, Vol. 15, p. 373, October, 1922.

The instruments used are the same as those used in preceding years, and include: Maximum and minimum thermometers; rain guage; self-recording anemometer; vane; and barometers. The observations at Orono now form an almost unbroken record of fifty-four years.

METEOROLOGICAL SUMMARY FOR 1922.

Observations Made at the University of Maine.

1922	January	February	March	April	May	June	July	August	September	October	November	December	Average	Total
Highest temperature	32	49	55	67	85	89	85	89	82	78	55	42	--------	--------
Lowest temperature	–17	–21	– 4	23	20	43	48	36	27	19	15	–21	--------	--------
Mean temperature	12.4	17.9	30.7	40.5	52.55	61.65	65.3	62.5	56.15	46.15	33.65	15.04	41.21	--------
Mean temperature in 54 years	16.00	14.98	30.29	40.10	51.31	60.86	66.05	65.92	59.44	50.47	37.63	23.79	43.09	--------
Total precipitation in inches	1.84	2.28	3.33	2.97	1.05	8.66	2.26	5.39	2.10	2.78	2.26	2.26	--------	37.18
Mean total precipitation in 54 years	2.53	3.45	3.92	2.94	3.41	3.45	3.44	2.36	3.37	3.74	3.40	3.35	--------	39.36
Number of days with .01 precipitation or more	5	10	8	9	5	16	7	11	6	12	8	10	--------	107
Snowfall in inches	16.0	20.5	4.0	9.0	--------	--------	--------	--------	--------	.75	.25	28.75	--------	79.25
Mean snowfall in 54 years	21.3	22.05	14.43	5.73	.215	--------	--------	--------	--------	.712	7.09	16.48	--------	--------
Number of clear days	19	12	13	7	13	5	14	10	16	12	8	10	--------	139
Number of fair days	8	6	12	10	12	16	13	12	11	9	12	8	--------	129
Number of cloudy days	4	10	6	13	6	9	4	9	3	10	10	13	--------	97
Average velocity of wind per hour in miles	5.195	5.129	6.048	6.591	6.673	5.144	4.45	3.809	4.078	5.744	4.587	5.33	5.23	--------

REPORT OF THE TREASURER.

The Station is a department of the University and its accounts are kept in the office of the Treasurer of the University. The books, voucher files, etc., are, however, all distinct from those of the other departments of the University. The classification of accounts is that prescribed by the auditors on the part of the Federal Government, and approved by the State Auditor. All of the accounts are audited by the State Auditor, and the Hatch Fund and Adams Fund accounts are also audited by the Office of Experiment Stations acting for the United States Secretary of Agriculture in accordance with Federal Law.

The income of the Station from public sources for the year that ended June 30, 1922, was:

U. S. Government, Hatch Fund appropriation	$15,000.00
U. S. Government, Adams Fund appropriation	15,000.00
State of Maine, Animal Husbandry investigation appropriation	5,000.00
State of Maine, Aroostook Farm investigation	5,000.00
State of Maine, Highmoor Farm investigations	5,000.00

The cost of maintaining the laboratories for the inspection analyses is borne by analysis fees and by the State Department of Agriculture. The income from sales at the experiment farms is used for the expense of investigations. The printing is paid for by an appropriation to the University.

At Aroostook Farm there are in connection with the cooperative work with the Federal Department of Agriculture expenditures mostly under "labor" for the Department and for which the Station is reimbursed. There are also certain expenditures for the Department made from sales of crops from Department investigations that do not appear in the tabular statements. They are carried as distinct and separate accounts, always with credit balances, on the Station ledger.

REPORT OF THE TREASURER FOR YEAR ENDING JUNE 30, 1922.

DISBURSEMENTS.

	Hatch Fund	Adams Fund	Animal Husbandry Investigations
Salaries	$6503.78	$13933.87	--------
Labor	2331.08	349.00	$2412.55
Publications	50.78	--------	16.08
Postage and Stationery	628.19	58.35	57.18
Freight and Express	234.04	21.15	164.19
Heat, light, water and power	706.63	33.76	125.51
Chemical and laboratory supplies	34.75	--------	--------
Seeds, plants and sundry supplies	893.08	16.85	338.59
Fertilizers	--------	--------	--------
Feeding Stuffs	2191.55	137.22	3027.31
Library	438.45	37.91	7.32
Tools, machinery and appliances	236.62	--------	--------
Furniture and fixtures	34.34	--------	7.48
Scientific apparatus and specimens	70.92	308.62	--------
Live stock	--------	--------	26.26
Traveling expenses	279.43	103.27	35.96
Contingent expenses	--------	--------	278.00
Buildings and land	366.36	--------	10.53
Total	$15000.00	$15000.00	$6506.96*

*$1506.96 from sales funds.

REPORT OF THE TREASURER FOR YEAR ENDING JUNE 30, 1922.

DISBURSEMENTS.

	Aroostook Farm	Highmoor Farm	General Account	Inspection Analysis
Salaries	$1165.00	$1558.37	--------	$11416.57
Labor	3909.15	3854.44	$15.59	--------
Publications	--------	--------	--------	--------
Postage and Stationery	34.00	66.12	.90	24.63
Freight and express	56.62	221.60	2.24	98.64
Heat, light, water and power	104.36	868.09	21.35	191.00
Chemical and laboratory supplies	65.25	--------	--------	187.77
Seeds, plants and sundry supplies	522.44	1889.19	53.69	23.88
Fertilizers	1230.00	392.44	--------	--------
Feeding stuffs	604.28	654.02	3.48	--------
Library	--------	--------	--------	--------
Tools, machinery and appliances	282.75	941.03	146.42	--------
Furniture and fixtures	79.93	88.54	--------	--------
Scientific apparatus and specimens	--------	60.00	--------	62.96
Live stock	--------	--------	--------	--------
Traveling expenses	4.02	54.34	26.96	18.93
Contingent expenses	62.35	13.00	33.74	5.00
Buildings and land	150.98	171.64	47.75	--------
Total	$8271.13*	$10832.82†	$352.12	$12028.48

*$3271.13 from sales funds.
†$5832.82 from sales funds.

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April, 1922

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

CHEMISTS.

James M. Bartlett, Chief	**C. Harry White, Assistant**
Elmer R. Tobey, Associate	***W. C. Weltman, Assistant**

Official Inspections

103

FOODS AND DRUGS

Jas. M. Bartlett.

The Commissioner of Agriculture is the executive of the law regulating the sale of foods and drugs in Maine. It is the duty of the Director of the Maine Agricultural Experiment Station to make the analyses of the samples collected by the Commissioner, and to publish the results of the analyses together with the names of the persons from whom the samples were obtained, and such additional information as may seem advisable.

Note. All correspondence relative to the inspection laws should be addressed to the Division of Inspections, Department of Agriculture, Augusta Maine.

*Until Sept. 1st, 1921.

EXAMINATION OF FOODS AND DRUGS.

In the following pages are given the results of the examination of food and drug samples collected by the inspectors of the Division of Inspections of the Department of Agriculture. The samples were, for the most part, purchased in the open market and are therefore the same as would be received by customers. The examinations were made to see if the goods conformed to the Food & Drug law and all violations of the law were reported to the Commissioner of Agriculture.

NON-ALCOHOLIC BEVERAGES.

Only eight samples of these materials were collected in 1921. They were examined for saccharin, cleanliness and proper branding. The results are given in the following table, arranged alphabetically by dealers' names. No saccharin was found in any of the samples.

Station number.	DEALER, BRAND AND MAKER.	Cleanliness	Marks on Bottles
	E. E. Bottling Co., Bangor.		
20153	Howdy	Sediment	Illegal
20154	Orange Kist Soda	No sediment	Illegal
20155	Cherry Blossoms	No sediment	Illegal
20156	Peach	Slight sediment	Illegal
20157	Smile	No sediment	Illegal
20158	Root beer	No sediment	Legal
20159	Lemon Kist Soda	Sediment	Illegal
	Wilson, E. C., Eastport.		
20198	Ginger Pop. Own make	Slight sediment	Legal

ICE CREAM.

Table showing the results of the examination of samples of ice cream collected in the season of 1921, arranged alphabetically by dealers. A lawful plain ice cream carries not less than 14 per cent milk fat. A fruit cream carries not less than 12 per cent milk fat.

Station number.	DEALER AND TOWN.	Kind of Cream	Lawful Fat Per cent	Fat Found Per cent
20174	Alkazin, E. N., Old Orchard	Vanilla	14.00	13.78
20175	Alkazin, E. N., Old Orchard	Chocolate	12.00	12.61
20194	Apollo Candy Shop, Portland	Vanilla	14.00	13.72
20195	Apollo Candy Shop, Portland	Chocolate	12.00	14.96
20301	Arey, Roscoe, Belfast	Vanilla	14.00	14.27
20227	Armsby & Davenport, Houlton	Strawberry	12.00	13.96
20313	Bar Harbor Tea Room, Bar Harbor	Vanilla	14.00	13.46
20318	Bartucci, A., Northeast Harbor	Banana	12.00	11.35
20183	Bernardini, Louis, Calais	Vanilla	14.00	10.52
20170	Bilodeau, Jean, Biddeford	Chocolate	12.00	13.14
20238	Bither, B. E., Augusta	Vanilla	14.00	16.79
20251	Blue Ship Tea Room, Boothbay Harbor	Vanilla	14.00	16.60
20240	Bogus Bros., Waterville	Vanilla	14.00	15.22
20211	Bon Bon Shop, Portland	Pineapple	12.00	13.18
20212	Bon Bon Shop, Portland	Lemon	14.00	14.96
20200	Boynton, J. W., West Pembroke	Chocolate	12.00	4.74
20228	Bragg, Mrs. F. H., Augusta	Vanilla	14.00	15.74
20311	Bridges, J. A., Sargentville	Vanilla	14.00	15.80
20287	Buckley, J. F., Lewiston	Vanilla	14.00	13.85
20312	Buckminister, R. M., Sedgwick	Walnut	12.00	11.09
20260	Bucknam, Frank, Skowhegan	Vanilla	14.00	14.73
20322	Burrill, C. L., East Holden	Vanilla	14.00	3.45
20214	Carolis, John, Portland	Strawberry	12.00	14.34
20215	Carolis, John, Portland	Grape Nut	12.00	15.32
20216	Carolis, John, Portland	Vanilla	14.00	16.55
20167	Christenson, James, Biddeford	Peach	12.00	12.84
20168	Christenson, James, Biddeford	Coffee	14.00	14.58

ICE CREAM.—Continued.

Station number.	DEALER AND TOWN.	Kind of Cream	Lawful Fat Per cent	Fat Found Per cent
20221	Clapp, W. L., Lincoln	Vanilla	14.00	14.93
20165	Clark, H. J., Biddeford	Chocolate	12.00	14.33
20166	Clark, H. J., Biddeford	Cherry	12.00	13.47
20280	Cobb, G. C., York Beach	Vanilla	14.00	15.47
20237	Cole, I. C., Pleasant Pond	Chocolate	12.00	2.92
20206	Connor, R. E., Castine	Vanilla	14.00	10.43
20302	Coombs Bros., Belfast	Vanilla	14.00	15.10
20326	Couture, E. J., Sanford	Vanilla	14.00	15.92
20274	Cutler, R. R., Round Pond	Pineapple	12.00	10.20
20235	Dearborn, E. N., Gardiner	Vanilla	14.00	16.08
20162	Delange, Ed., Biddeford	Vanilla	14.00	15.26
20163	Delange, Ed., Biddeford	Chocolate	12.00	12.99
20164	Delange, Ed., Biddeford	Grape Nut	12.00	15.12
20187	Delavena, Raymond, Portland	Chocolate	12.00	14.10
20243	DeOrsey, John, Waterville	Vanilla	14.00	15.61
20209	Devereux, Lowena, No. Castine	Vanilla	14.00	8.34
20300	Dodge, O. S., Isleboro	Vanilla	14.00	12.53
20285	Downing, M. T., Auburn	Vanilla	14.00	16.74
20169	Doyle, Katherine, Biddeford	Chocolate	12.00	15.38
20289	Dumont, E & Co., Lewiston	Vanilla	14.00	14.88
20189	Epstein, Robert, Portland	Chocolate	12.00	14.64
20120	Eureka Ice Cream Co., Island Falls	Vanilla	14.00	15.41
20217	Ft. Fairfield Drug Co., Ft. Fairfield	Strawberry	12.00	16.81
20262	Fossett, P. W., Round Pond	Vanilla	14.00	14.92
20263	Fossett, P. W., Round Pond	Strawberry	12.00	13.60
20275	Fournier, H. E., Brunswick	Vanilla	14.00	14.68
20335	Freeman, F. P., Harrison	Vanilla	14.00	13.01
20407	Gammon Brothers, Limestone	Grape Nut	12.00	15.62
20222	Glidden & Curtis, Gardiner	Vanilla	14.00	16.28
20293	Goodwin, C. W. & Son, Wells Beach	Vanilla	14.00	15.34
20239	Grant, Alton, Augusta	Vanilla	14.00	15.43
20282	Grant, Alton, Lewiston	Vanilla	14.00	20.09
20306	Grant, M. B., Sandy Point	Chocolate	12.00	12.99

ICE CREAM.—Continued.

Station number.	DEALER AND TOWN.	Kind of Cream	Lawful Fat Per cent	Fat Found Per cent
20225	Gray, Harvard, Hallowell	Vanilla	14.00	17.48
20309	Gray, Ray C., So. Brooksville	Chocolate	12.00	13.57
20140	Griney, D., Biddeford	Pineapple	12.00	12.31
20244	Hagar, W. A. & Co., Waterville	Vanilla	14.00	14.82
20411	Havener, C. M., Rockland	Vanilla	14.00	12.25
20267	Havener, Frances E., Rockland	Grape Nut	12.00	16.16
20268	Havener, Frances E., Rockland	Chocolate	12.00	12.04
20254	Hawkes, A. E. & W. H., Boothbay Harbor	Vanilla	14.00	14.18
20255	Hawkes, A. E. & W. H., Boothbay Harbor	Cherry	12.00	13.77
20307	Hill, W. T., Bucksport	Vanilla	14.00	12.39
20205	Hinckley, S. G., Blue Hill	Walnut	12.00	15.60
20199	Holmes, E. R., Eastport	Vanilla	14.00	13.38
20261	Hungerford, C. P., Winthrop	Pineapple	12.00	13.00
20337	Jewett, E. O., Fryeburg	Vanilla	14.00	7.02
20273	Johnson, H. H., Broad Cove	Chocolate	12.00	6.47
20223	Kennebec Creamery Co., Gardiner	Vanilla	14.00	14.85
20316	Keusher, Charles A., Bar Harbor	Chocolate	12.00	17.72
20290	Kostis Bros., Springvale	Vanilla	14.00	13.98
20327	Kostis Bros., Springvale	Vanilla	14.00	14.92
20193	Lad, I. F. & Son, Portland	Chocolate	12.00	15.02
20319	Lawton, Mrs. William, So. West Harbor	Peach	12.00	11.22
20305	Leach, Mrs. C. W., Stockton Springs	Chocolate	12.00	5.92
20334	Leavitt, J. D., Raymond	Vanilla	14.00	8.43
20281	Lewiston Candy Kitchen, Lewiston	Vanilla	14.00	15.75
20294	Lincoln, W. E., Vinal Haven	Vanilla	14.00	13.00
20201	Lingley, Mrs. Edgar, Dennysville	Vanilla	14.00	7.60
20278	Littlefield, C. S., Ogunquit	Vanilla	14.00	17.24
20310	Littlefield, Frederick B., Brooksville	Peach	12.00	9.10
20303	Lowell, R. W., Searsport	Vanilla	14.00	13.71
20317	McIntire, T. A., Seal Harbor	Chocolate	12.00	23.42
20185	Mahoney's Pharmacy, Biddeford	Vanilla	14.00	16.32
20186	Mahoney's Pharmacy, Biddeford	Chocolate	12.00	16.83
20119	Malloy, J. A., Bath	Vanilla	14.00	11.98

ICE CREAM.—Continued.

Station number.	DEALER AND TOWN.	Kind of Cream	Lawful Fat Per cent	Fat Found Per cent
20315	Marshall, W. B., Bar Harbor	Chocolate	12.00	15.80
20320	Mayo, W. R., Southwest Harbor	Chocolate	12.00	13.76
20349	Miller, Louis, Searsport	Vanilla	14.00	10.40
20232	Miller, Robert, Augusta	Vanilla	14.00	16.44
20321	Morange, H. W., Ellsworth	Chocolate	12.00	16.38
20271	Morris, John, Tenant's Harbor	Walnut	12.00	3.85
20192	Moustakes Bros., Portland	Chocolate	12.00	19.43
20233	Moustakes Bros., Portland	Chocolate	12.00	15.04
20234	Moustakes Bros., Portland	Vanilla	14.00	19.63
20188	Munjoy Ice Cream Co., Portland	Vanilla	14.00	16.42
20292	Norton, Arthur J., Wells Beach	Strawberry	12.00	16.89
20207	Noyes, Mrs. Grace D., Castine	Vanilla	14.00	18.64
20288	Olympia Ice Cream Parlor, Lewiston	Vanilla	14.00	14.16
20269	Packard, Wyman, Rockland	Strawberry	12.00	12.98
20226	Palmer, J. K., Houlton	Vanilla	14.00	23.94
20147	Paris, The, Biddeford	Chocolate	12.00	14.55
20252	Porter, E. L. & Co., Boothbay Harbor	Vanilla	14.00	15.55
20253	Porter, E. L. & Co., Boothbay Harbor	Chocolate	12.00	18.01
20145	Puritan Confectionary Store, Biddeford	Chocolate	12.00	14.48
20250	Pushor, E. H., Wiscasset	Vanilla	14.00	16.02
20298	Rankin Ice Cream Parlor, Richmond	Vanilla	14.00	13.92
20291	Raymond, Guy, Springvale	Vanilla	14.00	14.93
20328	Raymond, G. G., Springvale	Vanilla	14.00	13.62
20308	Richards, C. B., Bucksport	Vanilla	14.00	12.70
20196	Richardson, H. S., Eastport	Vanilla	14.00	13.58
20264	Robinson, Mrs. J. V., Warren	Caramel	14.00	10.20
20265	Robinson, Mrs. J. V., Warren	Vanilla	14.00	10.66
20266	Robinson, O. H., Warren	Orange	14.00	13.47
20283	Ross, Geo. A., Lewiston	Vanilla	14.00	16.08
20286	Ruggles, Fred L., Auburn	Vanilla	14.00	16.10
20340	Sanborn, Mrs. Julia, East Sebago	Vanilla	14.00	10.31
20258	Sawyer, F. E., Skowhegan	Vanilla	14.00	18.74
20304	Searsport Drug Co., Searsport	Vanilla	14.00	17.86
20339	Shaw, L. F., East Sebago	Vanilla	14.00	8.13
20270	Sheldon, C. W., Rockland	Chocolate	12.00	12.88

ICE CREAM.—Concluded.

Station number.	DEALER AND TOWN.	Kind of Cream	Lawful Fat Per cent	Fat Found Per cent
20272	Simmons, Mrs. Armand, Friendship	Vanilla	14.00	2.13
20231	Slosberg, Harry, Augusta	Vanilla	14.00	13.88
20213	Soule, George, Portland	Grape Nut	12.00	15.44
20191	The Spear Folks, Portland	Chocolate	12.00	14.40
20241	The Spear Folks, Waterville	Vanilla	14.00	16.52
20338	Spring, Miss Anne, Hiram	Caramel	14.00	6.86
20256	The Squirrel Tea Shop, Squirrel Island	Vanilla	14.00	14.11
20257	The Squirrel Tea Shop, Squirrel Island	Chocolate	12.00	12.11
20202	Stark & Sterritt, Machias	Vanilla	14.00	13.77
20279	Talpey, E. A., York Beach	Vanilla	14.00	14.86
20259	Tantish, E. C., Skowhegan	Vanilla	14.00	15.24
20325	Thompson's Pharmacy, Sanford	Vanilla	14.00	14.62
20190	Thuss, J. J. Estate, Portland	Chocolate	12.00	13.40
20184	Todd, Jane, Calais	Vanilla	14.00	13.02
20182	Tori Bros., Calais	Vanilla	14.00	14.15
20152	Trougakos, Louis, Saco	Vanilla	14.00	14.21
20336	Turner Center Dairying Association, Bridgton	Vanilla	14.00	15.98
20236	Varney, H. C., Richmond	Vanilla	14.00	10.72
20245	Verzoni Bros., Waterville	Vanilla	14.00	15.88
20277	Walson, D. W., Kennebunk Beach	Vanilla	14.00	14.38
20208	Wardwell, Mrs. Carl, Castine	Strawberry	12.00	7.74
20148	Waterville Ice Cream Co., Waterville	Vanilla	14.00	15.41
20149	Waterville Ice Cream Co., Waterville	Vanilla	14.00	15.55
20249	Webb, J. E. & V. L., Island Falls	Vanilla	14.00	13.00
20314	West End Drug Co., Bar Harbor	Chocolate	12.00	15.52
20197	Wilson, E. C., Eastport	Strawberry	12.00	11.26
20229	Winslow Ice Cream Parlor, Augusta	Vanilla	14.00	13.55
20284	Winslow & Scannell, Auburn	Vanilla	14.00	14.67
20171	Wiseman Farms, Old Orchard	Vanilla	14.00	13.99
20172	Wiseman Farms, Old Orchard	Banana	12.00	11.82
20173	Wiseman Farms, Old Orchard	Strawberry	12.00	14.39
20210	Wood, A. L., Portland	Cherry	12.00	14.16
20138	Wood, Sarah E., Surry	Vanilla	14.00	13.60
20204	Wood, Sarah E., Surry	Chocolate	12.00	15.77

OPENED CLAMS.

Results of examination of samples collected in 1921-22. The goods were, for the most part, purchased in the open market and were the same as would have been received by a customer purchasing at that time. Good fresh, well drained clams will carry not more than 10 per cent of liquids and not less than 17 per cent solids. If clams are soaked in fresh water they absorb much of the liquid and increase in bulk and decrease in per cent of solids. Consequently such clams are usually below the required standard. The results are arranged alphabetically by the dealers' names.

Station number.	DEALER AND TOWN.	Free Liquid	Solids	REMARKS.
20142	Andrews & Horrigan, Biddeford	1.39	19.57	Samples carrying 12 per cent or less of free liquids were passed. Free liquids 12 to 15 per cent dealer warned. More than 15 per cent free liquids hearings were recommended. Samples carrying not less than 17 per cent solids passed. Solids between 16 and 17 per cent, the dealer was warned. Less than 16 per cent solids hearings were recommended.
20276	Bailey, H. W., Portland	14.78	14.31	
20126	Beauchesne, Geo. E., Biddeford	26.65	15.72	
20129	Bibeau Bros., Biddeford	26.34	13.54	
20144	Bibeau Bros., Biddeford	13.46	17.49	
20176	Bragdon, Edward, Pine Point	1.44	21.94	
20131	Brunelle, A., Biddeford	15.43	17.98	
20141	Brunelle, A., Biddeford	1.74	20.61	
20390	Burnham, Fred H., Pine Point	8.35	18.49	
20130	Carrier's Market, Biddeford	27.37	12.49	
20146	Carrier's Market, Biddeford	20.43	15.33	
20134	Central Fish Market, Saco	9.11	18.38	
20133	Cressey & Graffam, Westbrook	19.70	17.65	
20391	Googins, Joseph E., West Scarboro	8.32	19.48	
20387	Harden, Roy, Pine Point	5.19	24.03	
20406	Jordan, Arthur L., Cape Elizabeth	24.47	21.04	
20394	Merrill, William, Pine Point	13.51	22.84	
20127	Paradis Bros., Biddeford	27.33	17.84	
20128	Paradis Bros., Biddeford	28.53	12.79	
20400	Sampson, Napoleon, Pine Point	19.23	23.39	
20177	Seavey, G. T., Pine Point	2.06	20.44	
20392	Seavey, Willis F., West Scarboro	7.17	19.28	
20136	Shaw, Geo. C. Co., Portland	24.00	16.93	

OPENED CLAMS.—Concluded.

Station number.	DEALER* AND TOWN.	Free Liquid	Solids	REMARKS.
20137	Shaw, Geo. C. Co., Portland	20.47	17.33	Samples carrying 12 per cent or less of free liquids were passed. Free liquids 12 to 15 per cent dealer warned. More than 15 per cent free liquids hearings were recommended. Samples carrying not less than 17 per cent solids passed. Solids between 16 and 17 per cent, the dealer was warned. Less than 16 per cent solids hearings were recommended.
20396	Skillings, Elmer, Pine Point	12.96	24.39	
20395	Skillings, George, Pine Point	7.44	19.59	
20401	Skillings, Haswell, Pine Point	17.83	20.27	
20378	Skillings, Herbert J., Pine Point	9.55	17.08	
20345	Skillings, Howard, Pine Point	32.94	22.97	
20346	Skillings, Howard, Pine Point	10.46	18.47	
20347	Skillings, Howard, Pine Point	28.93	22.81	
20348	Skillings, Howard, Pine Point	6.02	19.32	
20350	Skillings, Howard, Pine Point	24.29	24.21	
20355	Skillings, Howard, Pine Point	38.50	20.58	
20356	Skillings, Howard, Pine Point	7.91	17.79	
20357	Skillings, Howard, Pine Point	11.64	23.53	
20353	Snow, Ira W., Pine Point	36.90	20.60	
20354	Snow, Ira W., Pine Point	7.19	17.47	
20379	Snow, Ira W., Pine Point	7.14	17.70	
20380	Snow, Ira W., Pine Point	18.41	13.89	
20381	Snow, Ira W., Pine Point	8.82	15.99	
20382	Snow, Ira W., Pine Point	18.35	15.88	
20383	Snow, Ira W., Pine Point	12.62	16.75	
20384	Snow, Ira W., Pine Point	11.88	13.78	
20385	Snow, Ira W., Pine Point	13.53	18.91	
20386	Snow, Ira W., Pine Point	13.59	20.33	
20402	Snow, Ira W., Pine Point	15.03	18.54	
20388	Skillings, Lewellan, Pine Point	8.66	23.59	
20389	Staples, Harry W., Pine Point	4.46	20.82	
20393	Staples, Harry W., Pine Point	19.17	22.61	
20397	Turner, Charles C., Pine Point	19.29	21.41	
20398	Williams, Daniel F., Pine Point	9.47	17.54	
20399	Williams, George E., Pine Point	8.85	24.03	
20132	York Harbor Fish Market, Biddeford	16.54	17.58	
20143	York Harbor Fish Market, Biddeford	8.35	18.99	

LEMON EXTRACTS.

The following lemon extracts were collected by the inspectors and the results of the analyses are given in the following table. Extract of lemon should contain not less than 5 per cent lemon oil. Results are arranged alphabetically according to the dealers' names.

Station number.	DEALER, BRAND AND MAKER.	Net Volume	Lemon Oil
	Cloutier, C. H. & Co., Lewiston.		
20441	Baker's Pure Extract Lemon. Baker Extract Co., Portland.	2.00	6.00
20442	Colonial Brand Extract Lemon.	1.25	5.10
	Cole, Jerry, Skowhegan.		
20527	Hatchet Brand Lemon. Twitchell-Champlin Co., Portland.	2.00	5.60
	Deraney, Charles M., Portland.		
20218	Conwaide's Lemon Flavor. Economy Products Co., Portland.	1.88	5.09
	Direct Importing Co. Skowhegan.		
20524	Lemon Extract. Direct Importing Co., Boston.	2.00	5.20
	Hennewell, F. S., Bingham.		
20511	Foss' Pure Flavoring Extract. Schlotterbeck & Foss Co., Portland.	2.00	9.20
	Hurley, P. H., Richmond.		
20572	Close's Pure Extract Lemon. Close Mfg. Co., Portland.	2.00	5.00
	Lawrence, J. M., Solon.		
20533	Woods' Pure Extract of Lemon.	2.00	9.60
	Pooler, J. F., Skowhegan.		
20528	Pure Extract Lemon. Kimball Bros. & Co., Enosburg Falls, Vt.	1.75	6.60
	Rozzle, A., Lewiston.		
20452	Lemon.	2.00	5.50
20453	Lemon.	1.13	5.40
	Wentworth Grocery Co., Bingham.		
20513	Pure Extract Lemon. Frank E. Harris Co., Binghampton N. Y.	1.88	8.20

TERPENLESS EXTRACT LEMON.

Terpenless lemon extract is made by extracting the flavor from lemon oil by shaking it out with dilute alcohol and should contain not less than 0.2 per cent citral. One sample Brewster's Terpenless Extract Lemon, Station #20499, was obtained from J. W. Neal, North Berwick and was found to correspond to the guaranty.

VANILLA EXTRACTS.

Pure vanilla extract is the flavoring extract prepared from vanilla bean. The active principle that gives the flavor to vanilla is vanillin, and the best extracts properly prepared should contain from 0.15 to 0.30 of this compound. The following table gives the results of the analyses of the samples collected in 1921-22, arranged alphabetically by dealers' names. All of these goods were tested for courmarin and none was found.

Station number.	DEALER, BRAND AND MAKER.	Vanillin Per cent
	Atlantic & Pacific, Oakland.	
20512	Pure Vanilla Extract. The Great Atlantic & Pacific Tea Co.	0.20
	Beal, A. N., Lisbon Falls.	
20573	Extract Vanilla. Eli Lilly Co., Indianapolis, Ind.	0.30
	Cloutier, C. H. & Co., Lewiston.	
20439	Baker's Pure Extract Vanilla. Baker Extract Co., Springfield, Mass.	0.24
20440	Harris' Pure Extract Vanilla. Frank E. Harris Co., Binghamton, N. Y.	0.18
	Direct Importing Co., Skowhegan.	
20525	Vanilla Extract. Direct Importing Co., Boston.	0.25
	Goodwin Bros., Kennebunkport.	
20579	Burnett's Pure Extract Vanilla. Joseph Burnett Co., Boston.	0.22
	Heald, E. C. & Co., Solon.	
20534	Chamberlain's Extract of Vanilla.	0.21
	Hunnewell, F. S., Bingham.	
20510	Foss' Pure Flavoring Extract. Schlotterbeck & Foss Co., Portland.	0.19
	Jordan, John M., Richmond.	
20592	Close's Pure Extract Vanilla. Close Mfg. Co., Portland.	0.14
	LeClair, J. A., Waterville.	
20593	Three Crow Brand Extract Vanilla. The Atlantic Spice Co., Rockland.	0.24
	McIntire, L. W., Solon.	
20532	Burnett's Vanilla Extract.	0.26
	Preble & Robinson, Bingham.	
20515	Hatchet Brand Vanilla Extract. Twitchell Champlin Co., Portland.	0.20
20516	Gould's Pure Flavoring Extract. J. E. Gould & Co., Portland.	0.21
	Ray, W. H., Anson.	
20537	Revere Extract Vanilla. D. & L. Slade Co., Boston.	0.22
20538	Rival Pure Extract Vanilla. Frank E. Harris Co., Binghampton, N. Y.	0.16

VANILLA EXTRACTS.—Concluded.

Station number.	DEALER, BRAND AND MAKER.	Vanillin Per cent
20451	Rozzle, A., Lewiston. Vanilla.	0.20
20505	Savage, F. J., Fairfield. Baker's Pure Flavoring Extract.	0.23
20514	Wentworth Grocery Co., Bingham. Armour's Veribest Flavoring Vanilla Extract.	0.24

ARTIFICIAL OR IMITATION VANILLA.

Imitation vanilla flavor is made by using synthetic vanillin, courmarin, a flavor extracted from the tonker bean and artificial coloring matter. This flavor is usually quite strong and much less delicate than the pure vanilla extract. Only three samples of these goods were received and results obtained are given below.

Station number.	DEALER, BRAND AND MAKER.	Vanillin Per cent	Courmarin Per cent
20219	Deraney, Charles M., Portland. Everett's Vanilla Flavor. Economy Products Co., Portland.	0.104	0.048
20161	Johnson, Axel, Portland. Pioneer Brand Vanilla Flavor. Lawrence Chemical Co., Marietta, Ohio.	0.18	0.07
20324	Leech, Arthur L. Co., Kennebunk. Leech's Golden Glow Vanilla Flavor. Own make.	0.08	0.053

VINEGAR.

Vinegar, under the Maine Pure Food Law, is a product made from apple cider alone. A good well made cider vinegar will frequently carry from 5 to 6 per cent of acetic acid. A vinegar carrying 4 per cent acetic acid is lawful strength. As a vinegar carrying 4 per cent is lawful it has become a custom with the large makers of vinegar to reduce their product to about four per cent by the addition of water. This is an adulteration but is allowed provided the vinegar is properly labelled to show that this manipulation has been made.

PURE CIDER VINEGAR.

Table showing the results of the analyses of samples of vinegars collected in 1921. The United States standard for cider vinegar is not less than 4 per cent acid, 1.6 per cent apple solids and 0.25 ash. Results are arranged alphabetically by dealers' names.

Station number.	DEALER AND TOWN.	Manufacturer or Jobber	Acid	Apple Solids	Ash
20367	Beauleau Bros., Old Town	John Cassidy Co.	4.17	1.87	0.36
20246	Beaulieu, M. X., Presque Isle	Gameau Eveleth Co.	3.81	1.73	0.49
20343	Brunelle, A., Biddeford	F. X. Cote	5.16	0.95	0.28
20366	Campbell, L. S., Old Town	Maine Pickling Co.	4.47	2.31	0.30
20370	Danforth Bros., Brewer	Arthur Chapin Co.	3.60	1.89	0.37
20369	Flint, Geo. & Son, Brewer	Chas. Hayward Co.	4.44	1.92	0.33
20356A	Fox, E. R., Bangor	Thurston & Kingsbury	3.49	1.83	0.35
20360	Hamilton, C. G. & Co., Orono	Chas. Hayward Co.	4.62	2.21	0.42
20344	Harrison, J. W., Gorham	Own make	3.51	1.92	0.35
20374	Horn, Albert, Berwick	Maine Pickling Co.	4.32	2.36	0.32
20368	Kenney, L. A. & Son, Brewer	Arthur Chapin Co.	4.44	2.10	0.35
20358	McDonald, H. E., Bangor	Thurston & Kingsbury	4.29	1.87	0.37
20610	Milliken, C. S., Ea. Hiram	Stanton	5.01	2.47	0.48
20362	Peters, E. J., Orono	T. R. Savage Co.	4.20	1.63	0.31
20233	Tibbetts, B. B., Columbia Falls	T. R. Savage Co.	4.33	1.71	0.26
20355A	Townsend, Geo. E., Bangor	Arthur Chapin Co.	3.89	1.80	0.35

Cider vinegars reduced to standard strength by addition of water. Table showing results of analyses of samples collected in 1921. Results arranged alphabetically by dealers' names.

Station number.	DEALER AND TOWN.	Manufacturer or Jobber	Acid	Apple Solids	Ash
20595	Cates, Geo. H.	Kennebec Grocery Co.	4.29	2.14	0.38
20342	Delano, Chas. M. & Son, Bucksport	Lutz & Schram Co.	4.01		
20375	Eliot Trading Co., So. Eliot	Silas Pierce & Co.	4.26	1.81	0.26
20357A	Frank Grocery Co., Bangor	Twitchell-Champlin Co.	5.07	1.65	0.29
20373	Graham & Laundry, Berwick	J. T. Davis	4.17	2.26	0.43
20372	Hall, N. H. & Son, Brewer	John Cassidy Co.	4.47	2.25	0.34
20377	Ireland, Geo. Estate, Eliot	H. S. Melcher	3.87	1.73	0.27
20371	Marsh, F. B., Brewer	T. R. Savage Co.	4.44	2.81	0.59
20248	Mitton, Poland & Bishop, Caribou	Gameau Eveleth Co.	3.84	1.65	0.45
20376	Staples, J. F., Eliot	Haskell Adams Co.	4.14	1.72	0.27
20354A	Staples & Griffin, Bangor	Duffy-Mott Co.	4.20	1.92	0.34

Distilled vinegars and those not made from apple juice. Table showing results of analyses of samples collected in 1921. Results arranged alphabetically by dealers' names.

Station number.	DEALER AND TOWN.	Manufacturer or Jobber	Acid	Apple Solids	Ash
20365	Brissettes Market, Old Town	Lutz & Schram Co.	4.25	0.69	0.16
20363	Hoos Market, Old Town	Lutz & Schram Co.	4.11	0.23	0.11
20364	Mills, C. A., Old Town	Sawyer & Rand	2.79	0.44	0.04
20361	Page, Chester T., Orono	Lutz & Schram Co.	3.90	0.52	0.12
20359	Park, Jas. I., Orono	H. J. Heinz Co.	4.86	1.11	0.28
20247	Riley, E. W., Caribou	Gameau Eveleth Co.	3.84	0.20	0.03

HYDROCHLORIC ACID.

Table showing the results of examination of samples of hydrochloric acid purchased by the inspectors in 1921-22. Properly prepared U. S. P. hydrochloric acid contains 10 per cent of the acid. Samples have been passed if they came within 1 per cent of the standard.

Station number.	DEALER AND PLACE OF BUSINESS.	Hydrochloric Acid Per cent
20501	Bowdoin's Pharmacy, Kennebunk	10.44
20546	College Ave. Pharmacy, Waterville	11.76
20548	DeOrsay, John, Waterville	10.78
20419	Fifield & Co., Bangor	11.22
20518	Fogg, G. R., Skowhegan	11.19
20458	Hanson, Harry G., Portland	9.33
20450	Jones, O. W., Auburn	9.81
20437	Kenney Pharmacy, Lewiston	10.14
20551	Larkin Drug Store, Waterville	9.54
20443	Liggett Drug Store, Lewiston	9.87
20540	Madison Pharmacy, Madison	10.04
20536	Manter, Fred A., Anson	8.43
20507	Moore, E. W., Bingham	11.01
20555	Red Cross Pharmacy, Waterville	4.35
20522	Sampson's Drug Store, Skowhegan	10.61
20565	Wakefield, Earl C., Saco	31.49*

*Strong, not U. S. P.

SOLUTION OF MAGNESIUM CITRATE.

Table showing the results of analyses of magnesium citrate collected in 1921. According to the U. S. P. one hundred cubic centimeters should not contain less than 1.5 gram magnesium oxide. Theoretically, according to the formula, 100 c.c. should contain 2.05 grams magnesium oxide.

Station number.	DEALER, TOWN AND MAKER.	Grams Magnesium Oxide in 100 Cubic Centimeters
20491	Clark & Chick Drug Co., Biddeford. Cook Everett & Pennell	1.16
20483	Cumberland Ave. Pharmacy, Portland. Own make	1.77
20486	Davis, Sumner C. Jr., Portland. Own make	1.65
20489	Fors, Edward L., Portland. Own make	1.50
20487	Guppy, C. H. Co., Portland. Own make	1.67
20488	Hay, H. H. Sons, Portland. Own make	1.63
20482	Heseltine & Tuttle Co., Portland. Own make	2.01
20485	Liggett, Louis K. Co., Portland. Own make	1.50
20476	People's Pharmacy, Portland. Own make	1.34
20456	Power, Frank H., Portland. Own make	1.66
20454	Rankin, George W., Portland	1.77
20568	Sawyer. C. H., Saco. Brewer & Co	0.47
20569	Traynor. Charles F. & Co., Biddeford. Cook Everett & Pennell Co	1.06

Spirit of Camphor.

Table showing the results of analyses of samples of spirit of camphor collected in 1921-22. A properly prepared spirit of camphor contains, according to the U. S. Pharmacopoeia 9.5 to 10.5 per cent of camphor gum and 85 to 90 per cent alcohol. In passing on the goods examined considerable leeway has been allowed. If the gum was not under 9 per cent or over 11 per cent and the alcohol under 80 per cent the sample was passed. Any druggist if he used sufficient care in making the preparation should be able to easily come within these limits. Results are arranged alphabetically by dealers' names.

Station number.	Dealer and Place of Businss.	Camphor Gum Per cent	Alcohol Per cent
20434	Alden's Drug Store, Lewiston	10.4	85.46
20498	Alexander's Pharmacy. Ellsworth	10.4	85.84
20549	Allen Drug Store, Waterville	10.0	86.18
20494	Baillargeon, N. P., Biddeford	9.6	85.77
20588	Barrows & Barrows, Newport	10.0	86.28
20502	Bowdoin's Pharmacy, Kennebunk	10.0	86.71
20461	Boynton's Pharmacy, Brewer	9.2	83.64
20422	Brown Pharmacy, Bangor	10.4	85.87
20480	Burnham Drug Co., Old Town	10.0	85.94
20429	Curtis & Tupper, Bangor	9.6	84.51
20556	Davian, Geo. A., Waterville	10.4	85.09
20433	Davis, Chas. H., Bangor	10.4	83.67
20609	Duchesne, Charles, Biddeford	10.0	83.78
20581	Dudley-Weed Drug Co., Portland	10.4	86.35
20420	Fifield & Co., Bangor	10.8	85.19
20517	Fogg, G. R., Skowhegan	10.8	86.42
20560	Foster, S. J., Oakland	12.8	77.39
20424	Frawley Pharmacy, Bangor	10.4	81.56
20526	Fuller Drug Store, Skowhegan	10.8	83.51
20428	Ham, L. H., Bangor	9.6	85.10
20473	Hay, H. H. Sons, Portland	10.0	85.56
20603	Italian American Drug Store, Portland	13.2	80.72
20425	Jaynes, Riker, Bangor	10.4	82.26

SPIRIT OF CAMPHOR.—Concluded.

Station number.	DEALER AND PLACE OF BUSINESS.	Camphor Gum Per cent	Alcohol Per cent
20552	Jones Drug Store, Waterville	7.6	87.46
20474	Keefe, John D., Portland	10.0	86.67
20444	Liggett Drug Store, Lewiston	10.8	85.56
20531	McIntire, L. W., Solon	10.8	84.90
20460	Merrill Drug Co., Brewer	10.4	85.66
20576	Meserve, P. J., Brunswick	10.4	82.76
20578	Miller, E. C., Kennebunkport	6.4	89.93
20497	Moore, E. G., Ellsworth	10.0	86.45
20506	Moore, E. W., Bingham	9.6	85.73
20478	Mutty, W. Clement, Old Town	9.6	82.72
20544	Neal, F. H., Fairfield	10.0	85.66
20477	Nichols, Chas. F., Orono	10.0	86.96
20448	Packard, C. E., Auburn	10.4	85.59
20468	Park Drug Store, Portland	9.6	85.94
20585	Perkins, F. E., Corinna	10.0	86.01
20574	Robert's Pharmacy, Lisbon Falls	10.4	85.66
20465	Scanlan, J. M. Co., Portland	10.8	84.31
20484	Shaw, John M., Portland	10.4	85.33
20481	Staples Pharmacy, Old Town	10.0	85.49
20426	Warren, Ara Estate. Bangor	10.4	85.70
20504	Wilson Pharmacy, Fairfield	10.8	85.23
20541	Wright, E. W., Madison	10.4	86.01

SWEET SPIRITS OF NITRE.

Table showing the results of analyses of spirits of nitrous ether samples collected in 1921. According to the U. S. P., properly prepared spirit of nitrous ether should contain 4 per cent ethyl nitrite. It is a preparation that deteriorates rapidly unless properly kept. It should be prepared in small quantities and stored in well stoppered amber colored bottles in a dark, cool place. Results are arranged alphabetically by dealers' names.

Station number.	DEALER, TOWN AND MAKER.	Ethyl Nitrite Per cent
20435	Alden's Drug Store, Lewiston. Own make	3.46
20571	Bradbury, E. J., Saco	3.86
20520	Bucknam, F. W., Skowhegan. Own make	3.35
20583	Clark, R. E., Kittery. Own make	3.77
20421	Curran, E. E., Bangor. Own make	2.24
20496	Doyan, L. & Co., Biddeford. J. E. Gould Co.	3.75
20475	Flaherty, W. A., Portland	2.49
20561	Foster, S. J., Oakland. Own make	3.76
20467	Gamage's Pharmacy, Portland. Own make	3.56
20455	Hilton, Theara, Portland. Own make	3.25
20553	Jones Drug Store, Waterville. Own make	2.97
20586	Jones & McKesney, Newport. Brewer & Co.	3.57
20558	Loubier, Arthur, Waterville. Brewer & Co.	3.93
20457	McDonough, E. C., Portland. Own make	3.68
20529	McIntire, L. W., Solon. Cook, Everett & Pennell	3.51
20535	Manter, Fred A., Anson. Brewer & Co.	3.75
20577	Miller, E. C., Kennebunkport. Own make	2.97
20509	Moore, E. W., Bingham. J. E. Gould & Co.	3.59
20492	Morin Drug Co., Biddeford. Brewer & Co.	3.83
20470	Myrtle Pharmacy, Portland	2.27
20543	Neal, F. H., Fairfield. Own make	3.52
20447	Packard, C. E., Auburn. Own make	2.49
20599	People's Pharmacy, Portland	2.99
20481	Priest, H. H., Bangor. Own make	2.81
20432	Priest, H. H., Bangor. Own make	2.89

SWEET SPIRITS OF NITRE.—Concluded.

Station number.	DEALER, TOWN AND MAKER.	Ethyl Nitrite Per cent
20621	Sampson's Drug Store, Skowhegan. Own make	3.52
20597	Stover, R. B., Bucksport. Own make	2.57
20445	Wakefield Bros., Lewiston. Brewer & Co	4.04
20503	Wilson Pharmacy, Fairfield. Own make	4.13
20463	Winship, Frank L., Portland. Brewer & Co	2.15
20542	Wright, E. W., Madison. United Drug Co	3.47

TINCTURE OF IODINE.

Table showing the results of the analyses of samples of tincture of iodine collected in 1921-22. Properly prepared tincture of iodine contains in 100 mils (cubic centimeters) not less than 6.5 grams nor more than 7.5 grams of iodine and not less than 4.5 grams nor more than 5.5 grams of potassium iodide. Results are arranged alphabetically by dealers' names.

Station number.	DEALER, TOWN AND MAKER.	Iodine in 100 cc.	Potassium Iodide in 100 cc.	Alcohol Per cent
20462	Bowen, Michael J., Portland. Brewer & Co	7.31	4.94	87.00
20570	Boynton's Pharmacy, Biddeford	7.13	5.06	86.22
20566	Bradbury, E. J., Saco	6.96	5.05	84.96
20427	Buckley Drug Co., Bangor. H. K. Mulford	6.81	5.47	83.40
20519	Bucknam, F. W., Skowhegan. Eastern Drug Co	6.77	4.92	84.60
20430	Caldwell Sweet Co., Bangor	6.96	4.60	86.17
20584	Clark, R. E., Kittery. Own make	8.58	6.07	86.04
20545	College Ave. Pharmacy, Waterville	7.28	4.66	85.32
20587	Croxford, A. R. & Son, Newport. Brewer & Co	6.27	4.13	*
20557	Davian, G. A., Waterville	6.86	4.84	86.40
20464	Deering Drug Co., Portland. Own make	7.04	4.76	86.52
20547	DeOrsay, John, Waterville. United Drug Co	7.09	5.28	83.70

*Not enough sample for alcohol determination.

TINCTURE OF IODINE.—Concluded.

Station number.	DEALER, TOWN AND MAKER.	Iodine in 100 cc.	Potassium Iodide in 100 cc.	Alcohol Per cent
20567	Edward's Pharmacy, Saco	6.99	4.87	86.60
20493	Fortier's Pharmacy, Biddeford	6.32	5.22	81.48
20423	Fowler Drug Co , Bangor. Eastern Drug Co	6.47	5.29	84.57
20479	Fraser, Alexander, Old Town	6.84	5.02	81.94
20449	Getchell, H. W., Auburn. Brewer & Co	6.62	4.67	82.52
20472	Hawkins, Charles E., Portland	6.91	4.93	82.84
20459	Hinkley, Victor H., Brewer	6.48	4.44	*
20469	Holland, Francis J., Portland. J. E. Gould & Co	6.91	4.82	86.38
20490	Hovey, George W., Portland. Own make	6.74	4.89	84.06
20500	Hurd, R. H., No. Berwick. United Drug Co	7.26	5.05	83.00
20495	Jones' Pharmacy, Biddeford. Own make	6.62	4.42	83.52
20582	Keenan, William, Portland	7.04	4.95	86.04
20466	Keirstead, A. W., Portland. J. E. Gould & Co	6.26	4.76	78.64
20471	Kerwin, M. H., Portland. Brewer & Co	7.31	5.83	*
20550	Larkin Drug Store, Waterville. Brewer & Co	7.11	4.71	86.22
20559	Leighton & Cousins, Oakland. Sharp & Dohme	7.04	4.71	84.60
20436	Liggett Drug Store, Lewiston. Own make	6.99	4.78	82.28
20530	McIntire, L. W., Solon. Brewer & Co	6.99	5.01	86.04
20539	Madison Pharmacy, Madison. J. E. Gould & Co	6.72	5.26	84.78
20446	Martel Pharmacy, Lewiston. Park Davis, N. Y	6.57	4.55	83.16
20508	Moore, E. W., Bingham. United Drug Co	7.11	4.91	82.10
20596	Page, A. F., Bucksport. Eastern Drug Co	7.21	4.64	74.86
20438	Ricker, Warren E., Lewiston. Brewer & Co	6.78	4.62	86.38
20575	Roberts' Pharmacy, Lisbon Falls. Hance Bros. & White	7.11	4.85	86.78
20523	Sampson's Drug Store, Skowhegan. Brewer & Co	6.72	4.64	84.96
20554	Waterville Drug Store, Waterville. Eastern Drug Co.	7.13	5.02	86.60

*Not enough sample for alcohol determination.

MISCELLANEOUS FOOD SAMPLES.

No. 20123.—One sample Lafayette Brand Pure Cocoa bought of Augustus Holy, Ellsworth. Dealer purchased in bulk of T. R. Savage Co., Bangor. The examination and analysis showed the goods to be of good quality.

No. 20124.—A sample of cocoa bought of Holmes Swift Co., Augusta. The examination and analysis showed these goods to be of good quality.

No. 20409.—"Castanea Nuts" from Kosma & Marko, Portland. Purchased of New England Cold Storage Co. An examination showed that 25 per cent of the nuts were poor and unfit for food but the meats of 75 per cent of them were sweet and good. The whole lot had a musty odor.

No. 20410.—Castanea Nuts from James T. Jack, Portland, Maine. Purchased from Individew Co., Chicago. An examination showed that 25 per cent of the nuts were poor and unfit for food, but the meats of the remainder were sweet and good. The whole lot, however, had a musty odor.

No. 20135.—Candy (Chocolates) sent in by W. T. Boyd, Georgetown, Maine. The chocolates contained a flavoring syrup, but no alcohol.

No. 20602.—Liquid Cherries (Chocolates). These goods were sent in by the Police Department, Lewiston to ascertain if they contained any poison. No poison of any kind was found.

No. 20178.—Piels Sweet Cider. The analysis showed it to be apple cider carrying .53 per cent alcohol by volume.

No. 20295.—Cream: From H. G. Carver, Vinal Haven, Maine. Dealer purchased of Turner Center Dairying Association, Wiscasset. The sample carried 26.9 per cent fat.

No. 20224.—Heavy Cream. From Kennebec Creamery Co., Gardiner, Maine. Sample Tested 36.2 per cent fat.

No. 20134.—Klim (Powdered whole milk). Purchased of Peter Diamon, Portland. Dealer bought of Merrill-Soule Co., Syracuse, N. Y. The analysis indicated that the powder was made from whole milk and when dissolved in water according to directions made a milk up to the State standards.

No. 20605.—Carnation Sterilized Evaporated Milk. Dealer, Scott & Co., Bangor. Analysis showed the sample of good quality carrying 8.1 per cent fat.

No. 20604.—Armour's Veribest Evaporated Milk. Dealer, Scott & Co., Bangor. Analysis showed the sample of good quality carrying 8.08 per cent of fat.

No. 20220.—Sample of flour from E. G. Burns, Madison. The analysis of the sample showed it to be a good strong flour.

No. 20125.—Horse Radish bought from J. A. Haynes, Ellsworth, Maine. Marked Farmer's Horse Radish raised and prepared by W. L. Scribner, Monroe, Maine. Put up in pure cider vinegar. The examination showed the goods to be properly labelled.

No. 20180.—Jamaica Ginger. Submitted by County Attorney for Knox County to be tested for alcohol. It was found to contain 81.4 per cent Ethyl and no Methyl alcohol.

No. 20414.—Loganberries, 11 cans taken from Emanuel Goldstein, Bangor. The goods were packed by the Hillsboro Cannery Co., Hillsboro, Oregon. The examination showed that 8 cans were swollen and somewhat fermented. The other three were in good condition.

No. 20415.—Irvington Club Brand Loganberries. Taken from Emanuel Goldstein, Bangor. Packed by A. Rupert Co., Portland, Oregon. Out of 13 cans only 3 showed no evidence of swelling. Some of the cans were corroded. One can had blown.

No. 20121.—A. & P. Oleomargarine. Bought from the Atlantic & Pacific Store, Lewiston. The analysis of these goods showed them to be of good quality. The flavor was also good.

No. 20122.—A. & P. Oleomargarine. Sent in by the Health Officer, Lewiston. This sample proved to be identical with 20121.

No. 20418.—Pure Olive Oil . Bought from Kenton Grocery Co., Biddeford, Maine. The analysis showed this to be an olive oil of poor quality.

No. 20564.—Pure Olive Oil. Bought from the Portland Distributing Co. Own packing, Superior Quality. The analysis indicated that the oil was adulterated with cottonseed oil.

No. 20607.—Scallops. One sample taken from the Cox Sea Food Market, Bangor. The goods were of good quality, contained no free liquids and 18.55 per cent solids.

No. 20580.—Spinach. One sample of 3 cans, bought of L. A. Mercier, Portland. Mr. Mercier purchased of Milliken & Tomlinson, Portland. The examination showed that the cans were all short weight, but the goods were of the best quality.

No. 20118.—Pure Maple Syrup. Dealer: Gerald Strong, Winslow, Maine. Made at No. Newport, N. H. Analysis showed it to be pure maple and up to standards.

No. 20608.—Pure Maple Syrup. Dealer G. A. Strong, Waterville, Maine. Dealer purchased from Dandrow Bros., No. Newport, N. H. The analysis showed this to be a pure maple syrup but was below the required standard in solids.

No. 20323.—Nervtone Tablets. The tablets were found to contain arsenic and strychnine. They were taken because it was claimed that a child was poisoned by eating them.

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August, 1922

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

CHEMISTS.
James M. Bartlett, Chief
Elmer R. Tobey, Associate **C. Harry White, Assistant**

Official Inspections

104

COMMERCIAL FEEDING STUFFS, 1921-22

JAS. M. BARTLETT.

The Commissioner of Agriculture is the executive of the law regulating the sale of feeding stuffs in Maine. It is the duty of the Director of the Maine Agricultural Experiment Station to make the analyses of the samples collected by the Commissioner, and to publish the results of the analyses and such additional information as may seem advisable.

NOTE. All correspondence relative to the inspection laws should be addressed to the Division of Inspections, Department of Agriculture, Augusta, Maine.

INSPECTION OF FEEDING STUFFS.

In this bulletin are given the results of the analyses of feeding stuffs collected and analyzed after July 1st, 1921 and before July 1st, 1922. Nearly all the samples are official samples or those taken by the regular inspectors sent out by the Division of Inspections of the State Department of Agriculture. A list of the goods examined is given below, and the tables giving the guarantees and analyses are on the pages that follow.

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Analyses of Samples of Feeding Stuffs.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	COTTONSEED MEALS.				
	American Cotton Oil Co., New York, N. Y.				
9385	ACo Brand Cottonseed Meal	Oakland	G* 41.18	10.00	7.00
			F* 41.83	9.77	7.94
9463	Longhorn Brand Prime Cottonseed Meal	Unity	G 43.00	12.00	6.00
			F 44.13	8.30	9.69
9274	Surety Brand Cottonseed Meal	Portland	G 36.00	14.00	5.50
			F 36.31	13.37	7.79
9473	Surety Brand Cottonseed Meal	Brooks	F 37.00	14.08	6.66
9521	Surety Brand Cottonseed Meal	Portland	F 37.94		
	F. W. Brode & Co., Memphis, Tenn.				
9495	Owl Brand 41 Cottonseed Meal	Foxcroft	G 41.00	10.00	6.00
			F 43.13	9.92	7.81
	Brown-Jossylin Co.				
9477	White Mule Brand Prime Cottonseed Meal	Brooks	G 41.00	11.00	6.00
			F 45.50	8.84	6.71
	Buckeye Cotton Oil Co., Cincinnati, Ohio				
9519	C. S. Meal	Bangor	G 36.00		
			F 40.32		
	East St. Louis Cotton Oil Co., National Stock Yards, Ill.				
9516	Cottonseed meal, St. Clair Brand	Ea. Newport	G 36.00	16.00	5.00
			F 36.88	12.70	6.48
	Hood & Co., Dallas, Texas				
9479	Excell Brand Cottonseed Cake and Meal	Belfast	G 36.00	12.00	5.00
			F 38.63	13.10	6.04
	Humphreys-Godwin Co., Memphis, Tenn.				
9285	Bull Brand Cottonseed Meal	Belfast	G 43.00	10.00	5.00
			F 43.00	9.73	9.01
9504	Bull Brand Cottonseed Meal	Milo	F 43.38	9.49	8.38
9434	Cottonseed Meal	Portland	G 36.00	15.00	5.00
			F 36.06		
9492	Danish Brand Cottonseed Meal	Corinna	G 36.00	15.00	5.00
			F 37.50	12.60	6.89
9518	Danish Brand Cottonseed Meal	Portland	F 37.13		
9517	Danish Brand Cottonseed Meal	Portland	F 36.00		
9418	Danish Brand Cottonseed Meal	Gardiner	F 37.38	11.81	7.27
9424	Danish Brand Cottonseed Meal	Hallowell	F 38.38	11.89	7.87
9462	Danish Brand Cottonseed Meal	Portland	F 36.00		
9271	Danish Brand Cottonseed Meal	Portland	F 37.38	10.32	7.81
9268	Danish Brand Cottonseed Meal	Portland	F 34.70		
9490	Dixie Brand Cottonseed Meal	Dexter	G 41.00	10.00	5.00
			F 41.00	11.08	7.54
9407	Dixie Brand Cottonseed Meal	Bucksport	F 43.63	7.50	9.36
	Jennings-Brown Co.				
9452	Robin Brand Good Cottonseed Meal	Brunswick	G 36.00	14.00	5.00
			F 36.38	14.13	6.53
	L. B. Lovitt & Co., Memphis, Tenn.				
9273	Cottonseed Meal	Auburn	G 41.00		
			F 41.32		
9525	Lovitt Brand Cottonseed Meal	Norway	G 43.00	10.00	6.00
			F 41.62		
9323	Thirty-Six Brand Cottonseed Meal	Portland	G 36.00	14.00	5.00
			F 37.00	16.91	7.08
9275	Thirty-Six Brand Cottonseed Meal	Portland	F 33.69		
	Marianna Cotton Oil Co., Marianna, Ark.				
9483	Cottonseed Meal	Skowhegan	G 43.00	11.00	7.00
			F 44.63		

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*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	COTTONSEED MEALS.—Concluded.				
9515	Good Cottonseed Meal	Livermore Falls	G* 36.00	14.00	5.00
			F* 36.13		
9460	Good Cottonseed Meal	Livermore Falls	F 35.57		
9461	Prime Cottonseed Meal	Auburn	G 43.00	11.00	7.00
			F 45.19		
9506	White Mule Brand Cottonseed Meal	Portland	G 36.00	14.00	5.00
			F 38.00	13.11	7.64
	A. C. Westervelt & Co., Memphis, Tenn				
9496	Planet Brand Cottonseed Meal	Guilford	G 43.00	10.00	6.00
			F 46.88	7.93	8.23
9493	Star Brand Cottonseed Meal	Dover	G 41.00	10.00	5.50
			F 42.50	11.05	7.53
	LINSEED MEALS.				
	American Milling Co., Peoria, Ill.				
9345	Amco Old Process Linseed Meal and Old Process Screening Oil Feed	Portland	G 30.00	10.00	5.00
			F 32.88	8.92	6.31
	Midland Linseed Prod. Co., Minneapolis, Minnesota				
9371	Pure Old Process Ground Linseed Cake	Waterville	G 30.00	9.50	5.00
			F 31.25	8.35	9.30
	GLUTEN MEALS.				
	Corn Products Refining Co., New York				
9469	Diamond Corn Gluten Meal	Thorndike	G 40.00	4.00	1.00
			F 39.75	2.00	2.53
	GLUTEN FEEDS.				
	American Maize Prod. Co., New York				
9487	Cream of Corn Gluten Feed	Dexter	G 23.00	8.50	1.50
			F 25.25	6.77	4.14
	Corn Products Refining Co., New York				
9284	Buffalo Corn Gluten Feed	Belfast	G 23.00	8.50	1.00
			F 24.00	7.01	5.18
	Perrick & Feed				
9507	Douglass Corn Gluten Feed	Ellsworth	G 23.00	8.00	1.50
			F 26.13	8.35	1.91
	A. E. Staley Mfg. Co., Decatur, Ill.				
9313	Staley's Corn Gluten Feed	Bangor	G 23.00	8.00	1.00
			F 24.38	6.70	3.47
	COMPOUNDED FEEDS, GROUND FOR HORSES AND CATTLE.				
	The Akron Feed & Milling Co., Akron, Ohio				
9308	Portage Stock Feed	Bangor	G 8.50	10.00	4.00
			F 8.25	11.60	3.33
	American Milling Co., Peoria, Ill.				
9357	Amco Dairy Feed	Augusta	G 25.00	8.00	5.00
			F 27.75	8.00	5.59
9358	Empire 20% Dairy Feed	Augusta	G 20.00	8.00	4.50
			F 23.50	6.52	5.16
	The Ansted & Burk Co., Springfield, Ohio				
9384	Ohio Farm Feed	Oakland	G 11.00	8.50	4.00
			F 14.88	8.03	4.64
	E. W. Bailey & Co., Montpelier, Vt.				
9503	Capital Dairy Ration	Milo	G 23.00	10.00	5.50
			F 23.63	8.15	6.86
9505	Pennant Brand Stock Feed	Milo	G 9.00	12.00	5.00
			F 11.75	9.40	6.49
	Bangor Farmers' Union, Bangor, Maine				
9307	Bangor Union Ration	Bangor	G 19.00	12.00	3.50
			F 21.75	12.87	5.12
	Batchelor Flour Mills Co., Waterville, Maine				
9484	Kennebec Dairy Ration	Waterville	G 20.63	7.54	5.19
			F 20.63	7.54	5.19

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*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken		Protein	Fiber	Fat
				%	%	%
	COMPOUNDED FEEDS, GROUND FOR HORSES AND CATTLE.—Continued.					
	Chapin & Co., Chicago, Ill.					
9282	Unicorn Dairy Ration	Belfast	G*	24.00	10.00	5.00
			F*	25.50	8.63	6.57
	Clover Leaf Milling Co., Buffalo, N. Y.					
9324	Advanced Registry Dairy Feed	Portland	G	25.00	10.00	5.00
			F	26.75	10.18	6.85
9447	Cloverdale Horse Feed	Brunswick	G	10.00	11.00	2.50
			F	11.88	7.28	4.38
9333	Cloverdale Milk Grains	Portland	G	24.00	10.00	5.00
			F	26.88	10.60	5.73
9329	Clover Leaf Calf Meal	Portland	G	25.00	7.00	5.00
			F	24.00	5.53	5.85
9326	Master Grain Ration	Portland	G	24.00	10.00	5.00
			F	21.80	9.24	5.47
9446	Peerless Milk Ration	Brunswick	G	20.00	12.00	4.50
			F	24.63	8.53	5.77
	Chas. M. Cox Co., Boston, Mass.					
9443	Charlestock Feed	Freeport	G	10.00	14.00	4.00
			F	11.13	9.47	6.45
9435	Paragon Dairy Feed	Bucksport	G	22.00	14.00	4.00
			F	24.25	12.52	5.90
9438	Wirthmore Balanced Ration for Milch Cows	Richmond	G	25.00	11.00	5.50
			F	25.63	9.58	6.85
9286	Wirthmore Stock Feed	Belfast	G	9.00	9.50	4.00
			F	10.88	9.68	5.74
	Eastern Grain Co., Bangor, Maine					
9423	Eastern's Growing Feed	Hallowell	G	16.00	8.00	4.00
			F	19.00	8.54	7.45
9318	Eastern's Hog Meal 10% Digester Tankage	Old Town	G	18.00	8.00	5.00
			F	16.38	5.44	6.59
9295	Eastern's 25 Ready Ration	Pittsfield	G	25.00	10.00	5.00
			F	28.88	10.46	6.13
9315	Eastern's 24 Dairy Ration	Bangor	G	24.00	12.00	5.00
			F	25.13	9.13	6.22
9294	Eastern's White Stock Feed	Pittsfield	G	10.00	10.00	3.00
			F	11.38	7.18	4.57
	Elmore Milling Co., Oneonta, N. Y.					
9380	Elmore Milk Grains	Waterville	G	25.00	11.00	6.00
			F	26.25	10.10	5.21
	John W. Eshelman & Sons, Lancaster, Pa.					
9296	Eshelman's Calf Meal	Pittsfield	G	16.00	3.00	3.00
			F	26.75	4.13	5.89
9417	Eshelman's Calf Meal	Gardiner	G	16.00	3.00	3.00
			F	23.25	4.42	5.62
9340	Eshelman's 85 Horse Feed	Portland	G	9.00	12.00	3.00
			F	11.00	6.58	3.93
9337	Eshelman's Hog Meal	Portland	G	16.00	6.00	5.00
			F	17.00	5.47	6.88
9336	Eshelman's 24 Dairy Feed	Portland	G	24.00	12.00	5.00
			F	25.25	7.85	5.52
	D. H. Grandin Mlg. Co., Jamestown, N. Y.					
9367	Grandin's Milk Maker	Bangor	G	20.00	12.00	5.00
			F	22.25	8.90	7.40
9395	Grandin's Stock Food	Skowhegan	G	9.00	12.00	5.00
			F	9.63	8.33	6.19
9396	Grandin's 24% Balanced Dairy Ration	Skowhegan	G	24.00	10.00	5.00
			F	26.50	8.54	7.14
9368	Grandin's Twin Six Dairy Feed	Bangor	G	22.00	12.00	5.00
			F	25.38	9.69	7.06
	The Gwinn Milling Co., Columbus, Ohio					
9390	Gwinn's Dairy Feed	Skowhegan	G	14.00	11.00	4.00
			F	14.88	7.70	5.05

*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein		Fiber	Fat
				%	%	%
	COMPOUNDED FEEDS, GROUND FOR HORSES AND CATTLE.—Continued.					
	J. B. Ham Co., Lewiston, Maine					
9450	Orono Dairy Feed	Brunswick	G*	20.00	10.00	4.50
			F*	20.63	7.77	5.09
	Illinois Feed & Elevator Co., Bloomington, Ill.					
9410	Homestead Dairy Feed	So. Brewer	G	22.00	10.00	5.00
			F	23.00	6.71	5.27
9411	Homestead Stock Feed	So. Brewer	G	9.00	9.00	3.50
			F	9.13	7.65	3.66
	International Sugar Feed Co., Minneapolis, Minn.					
9454	Diamond Dairy Feed	Brunswick	G	24.00	10.00	5.00
			F	24.38	9.62	6.59
9457	Int. Climax Dairy Feed	Brunswick	G	12.50	15.00	4.00
			F	12.38	13.86	4.83
	Chas. A. Krause Milling Co., Milwaukee, Wisconsin					
9456	Badger Stock Feed	Brunswick	G	10.00	10.00	3.25
			F	10.88	9.46	3.65
	The Larrowe Milling Co., Detroit, Mich.					
9293	Larro	Pittsfield	G	20.00	14.00	3.50
			F	22.75	11.07	4.88
	Merrill & Mayo Co., Waterville, Me.					
9372	Elm City Dairy Ration	Waterville	G	25.00	11.00	6.00
			F	25.38	11.41	8.52
9376	Elm City Stock Feed	Waterville	G	10.00	12.00	4.00
			F	9.38	7.32	6.01
	National Milling Co., Toledo, Ohio					
9346	Osota Feed	Portland	G	15.00	10.00	4.50
			F	19.75	8.09	6.31
	New England Grain Co., Portland, Me.					
9513	New England Stock Feed	Ellsworth	G	9.00	9.50	4.00
			F	9.75	8.76	5.28
	The Park & Pollard Co., Buffalo, N. Y.					
9292	Stevens 44 Dairy Ration	Pittsfield	G	24.00	14.00	5.00
			F	27.75	11.63	7.98
9355	Stevens Milkade Calf Meal	Augusta	G	20.00	7.50	8.00
			F	24.88	5.00	9.27
	Purity Oats Co., Davenport, Iowa					
9430	Iowa Stock Feed	Augusta	G	10.00	12.75	4.00
			F	11.13	12.10	6.30
	The Quaker Oats Co., Chicago, Ill.					
9303	Big Q Dairy Ration	Bangor	G	21.00	12.00	4.50
			F	21.88	10.29	7.16
9429	Buckeye Feed	Augusta	G	15.50	11.00	4.50
			F	17.25	9.03	5.65
9356	Schumacher Feed	Augusta	G	10.00	12.00	3.25
			F	10.88	10.76	4.66
9299	Schumacher Feed Sugared	Bangor	G	10.00	12.00	3.25
			F	12.25	5.21	4.53
	Ryde & Co., Chicago, Ill.					
9403	Rydes Cream Calf Meal	Newport	G	25.00	6.75	5.00
			F	25.00	6.78	5.24
	St. Albans Grain Co.					
9485	Provender	Portland	F	10.88	4.64	4.65
	Sheffield King Milling Co., Minneapolis, Minn.					
9349	Gold Mine Feed	Augusta	G	15.00	10.00	4.50
			F	17.75	10.34	5.53
	David Stott Flour Mills, Detroit, Mich.					
9426	Stott's Winner Feed	Augusta	G	8.50	10.00	3.50
			F	9.00	8.08	4.70

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*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	COMPOUNDED FEEDS, GROUND FOR HORSES AND CATTLE.—Concluded.				
	Ubiko Milling Co., Cincinnati, Ohio				
9386	Union Grains	Skowhegan	G* 24.00	10.00	5.00
			F* 25.63	7.97	6.11
	U. S. Food Prod. Co., New York, N. Y.				
9433	Farmer Jones Dairy Feed	Augusta	G 20.00	9.00	5.00
			F 24.25	8.66	5.65
9434	Mel-O Dairy Ration	Augusta	G 20.00	9.00	5.00
			F 25.13	9.90	5.87
	Wiscasset Grain Co., Wiscasset, Me.				
9277	Creamery Cow Feed	Wiscasset	G 20.00	10.00	5.00
			F 20.50	8.42	5.79
9276	Creamery Cow Feed	Wiscasset	F 19.63	8.60	6.10
	COMPOUNDED FEEDS FOR POULTRY, MASH.				
	Batchellor Flour Mill Co., Waterville				
9379	Dry Mash	Waterville	F 22.00	7.50	5.29
	F. H. Brastow & Son, So. Brewer, Me.				
9412	Monarch Poultry Mash	So. Brewer	G 20.00	7.00	5.50
			F 18.88	7.35	5.95
	Chas. M. Cox Co., Boston, Mass.				
9312	Wirthmore Buttermilk Mash Feed. Fish & Meat Scraps	Bangor	G 20.00	8.50	4.00
			F 19.44	5.03	4.69
9398	Wirthmore Growing Feed with Dried Buttermilk & Beef Scraps	Skowhegan	G 15.00	4.50	4.50
			F 18.88	3.40	6.11
	John C. Dow Co., Boston, Mass.				
9365	Dow's Favorite Poultry Meal	Bangor	G 30.00		10.00
			F 28.31		13.65
	Eastern Grain Co., Bangor, Maine				
9314	Eastern's Laying Egg Mash	Bangor	G 20.00	7.00	5.00
			F 23.38	5.82	7.48
	John W. Eshelman & Son, Lancaster, Pa.				
9338	Eshelman's Growing Mash	Portland	G 16.00	8.00	4.00
			F 18.63	5.30	6.34
9339	Eshelman's Laying Mash	Portland	G 20.00	7.00	5.00
			F 21.25	5.82	7.33
	D. H. Grandin Mlg. Co., Jamestown, N. Y.				
9391	Grandin's Growing Feed	Skowhegan	G 14.00	8.00	4.00
			F 16.75	7.28	6.03
	Greene Chick Feed Co., Marblehead, Mass.				
9439	Greene's Poultry Food	Richmond	G 35.00	0.00	5.00
			F 38.25		10.87
	J. B. Ham Co., Lewiston, Maine				
9449	Orono Dry Mash	Brunswick	G 17.00	12.00	4.50
			F 19.88	9.14	5.70
	Oscar Holway Co., Auburn, Maine				
9489	Dirigo Egg Mash	Dexter	G 16.00	10.00	3.00
			F 22.00	7.20	5.82
	Merrill & Mayo Co., Waterville, Me.				
9374	Elm City Dry Mash	Waterville	G 18.00	12.00	1.50
			F 23.25	5.58	7.20
	New England Grain Co., Portland, Me.				
9334	New England Egg Mash	Portland	G 18.00	10.00	4.00
			F 20.63	9.72	5.53
	The Park & Pollard Co., Boston, Mass.				
9362	Growing Feed	Augusta	G 10.00	8.00	1.50
			F 15.63	3.98	5.87
9301	Lay or Bust Dry Mash	Bangor	G 18.00	12.00	1.50
			F 22.50	6.16	6.20
9328	Leghorn Lay or Bust Special	Portland	G 21.00	10.00	1.50
			F 24.38	5.43	5.89

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*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	COMPOUNDED FEEDS FOR POULTRY, MASH.—Concluded.				
	The Quaker Oats Co., Chicago, Ill.				
9304	Ful O Pep Dry Mash	Bangor	G* 20.00	10.00	4.00
			F* 22.00	7.62	6.53
9305	Ful O Pep Growing Mash	Bangor	G 17.00	9.00	5.25
			F 21.88	4.73	6.67
	UNGROUND FEEDS FOR POULTRY.				
	American Milling Co., Peoria, Ill.				
9351	Cluck Cluck Scratch Feed	Augusta	G 10.00	5.00	2.50
			F 10.38	3.76	3.88
	The Ansted & Burk Co., Springfield, Ohio				
9382	Humpty Dumpty Scratch Feed	Oakland	G 11.00	4.00	3.00
			F 10.13	2.68	3.57
	Clover Leaf Milling Co., Buffalo, N. Y.				
9330	Clover Leaf Mills Developing Feed	Portland	G 10.00	5.00	2.50
			F 10.38	1.85	3.25
9327	Peerless Scratch Grains	Portland	G 10.00	5.00	2.50
			F 10.00	2.60	3.95
	Chas. M. Cox Co., Boston, Mass.				
9310	Wirthmore Gritless Intermediate Chick Feed	Bangor	G 11.00	3.50	3.00
			F 9.88	2.37	2.96
9311	Wirthmore Scratch Feed	Bangor	G 11.00	5.00	3.00
			F 11.25	3.66	3.68
	Eastern Grain Co., Bangor, Maine				
9343	Eastern's Chick Feed	Portland	G 10.00	3.00	3.00
			F 10.00	2.17	3.69
9317	Eastern's Screened Scratch Feed	Old Town	G 9.00	4.00	3.00
			F 10.13	2.54	3.11
	John W. Eshelman & Son, Lancaster, Pa.				
9341	Imperial Scratch Feed	Portland	G 9.00	4.00	3.00
			F 10.13	2.42	3.73
	D. H. Grandin Milling Co., Jamestown, N. Y.				
9370	Grandin's Screened Scratch Feed	Bangor	G 10.00	5.00	2.50
			F 10.63	2.55	2.78
	Oscar Holway Co., Auburn, Maine				
9502	Dirigo Scratch Feed	Guilford	G 10.00	5.00	2.50
			F 10.88	2.62	3.27
	Illinois Feed & Elevator Co., Bloomington, Ill.				
9414	Homestead Scratch Feed	So. Brewer	G 9.00	5.00	3.00
			F 10.50	2.82	4.21
9413	Illinois Fancy Scratch Feed	So. Brewer	G 9.00	5.00	3.00
			F 9.88	3.08	3.70
	Merrill & Mayo Co., Waterville, Maine				
9375	Elm City Scratch Feed	Waterville	G 10.00	5.00	2.50
			F 10.75	2.61	2.55
	The Park & Pollard Co., Boston, Mass.				
9361	Intermediate Chick Feed	Augusta	G 10.00	5.00	1.50
			F 10.00	2.27	3.25
9360	Pontiac Scratch Feed	Augusta	G 10.00	5.00	1.50
			F 10.13	2.67	3.28
9363	Red Ribbon Scratch Feed	Augusta	G 10.00	5.00	1.50
			F 11.13	3.18	3.69
	The Quaker Oats Co., Chicago, Ill.				
9306	Ful O Pep Scratch Grains	Bangor	G 9.00	5.00	2.00
			F 10.63	2.43	3.20
	ANIMAL PRODUCTS.				
	American Agricultural Chemical Co., New York, N. Y.				
9402	Protox Pure Ground Meat Scraps	Newport	G 55.00		10.00
			F 59.25		13.27

*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	ANIMAL PRODUCTS—Concluded.				
	C. F. Davis Packing Co., Fleeton, Va.				
9443	Chesapeake Fish Meal	Freeport	G* 50.00		8.00
			F* 60.13		7.66
	John C. Dow Co., Boston, Mass.				
9366	Dow's Beef Scraps	Bangor	G 43.00		12.00
			F 46.25		16.28
	Portland Rendering Co., Portland, Me.				
9387	Portland Bone Meal	Skowhegan	G 25.00		5.00
			F 26.94		5.12
9298	Portland Bone & Meat Meal	Bangor	G 30.00		8.00
			F 36.13		10.39
9321	Portland Cooked Meat and Bone Scrap	Old Town	G 40.00		8.00
			F 46.38		13.32
	Whitman & Pratt Rendering Co., Boston				
9442	Doublex Pure Beef Scraps	Freeport	G 55.00		10.60
			F 49.32		17.98
9441	Meat and Bone Poultry Scrap	Freeport	G 40.00		12.00
			F 40.63		14.92
	CORN AND OATS GROUND.				
	F. H. Brastow & Son, So. Brewer, Me.				
9417	Monarch Ground Feed	So. Brewer	G 10.00	6.00	5.00
			F 11.50	4.59	5.23
	Eastern Grain Co., Bangor, Maine				
9477	Corn & Oat Chop	Brooks	G 10.00	5.00	4.00
			F 11.63	4.84	5.15
	J. B. Ham Co., Lewiston, Maine				
9451	Corn & Oat Chop	Brunswick	G 10.00	5.00	4.00
			F 11.00	4.45	4.35
	Merrill & Mayo Co., Waterville, Me.				
9378	Corn & Oat Chop	Waterville	G 10.00	6.00	5.00
			F 10.75	5.20	4.08
	New England Grain Co., Portland, Me.				
9422	Ground Corn & Oats	Gardiner	G 10.00	6.00	4.00
			F 10.88	9.13	4.83
9511	Ground Corn & Oats	Ellsworth	F 11.38	4.37	4.31
	HOMINY FEED.				
	Chas .A. Krause Mlg. Co., Milwaukee, Wisconsin				
9458	Badger White Hominy Feed	Brunswick	G 10.00	5.00	5.00
			F 11.25	5.72	6.87
	Mystic Mills. Int. Milling Co., Sioux City, Iowa				
9486	Mystic White Hominy Feed	Portland	G 8.50	5.00	4.00
			F 11.25	4.03	6.93
	OAT HULLS.				
	Armour Grain Co., Chicago, Ill.				
9369	Oat Hulls	Bangor	G 4.00	30.00	1.50
			F 5.50	26.85	2.16
	The Quaker Oats Co., Chicago, Ill.				
9432	Oat Hulls Ground	Augusta	G 5.00	28.00	2.00
			F 6.25	24.55	3.59
	DRIED BEET PULP.				
	The Larrowe Milling Co., Detroit, Mich.				
9322	Dried Beet Pulp	Old Town	G 8.00	20.00	0.50
			F 10.13	20.20	1.76
	WHEAT BY-PRODUCTS BRAN				
	The Allen & Wheeler Co., Troy, Ohio				
9467	Trojan Bran	Thorndike	G 14.50	9.50	4.00
			F 15.50	10.49	4.79
	The Ansted & Burk Co., Springfield, Ohio				
9392	Bran	Skowhegan	G 15.50	9.50	4.01
			F 17.25	9.99	6.16

*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	WHEAT BY-PRODUCTS.				
	BRAN.—Continued.				
	Colburn Bros. Co.				
9421	Wheat Bran & Screenings	Gardiner	G* 14.50	10.00	3.50
			F* 16.75	9.64	5.55
	Commander Mill Co., Minneapolis, Minn.				
9491	Commander Wheat Bran	Corinna	G 14.50	11.50	5.00
			F 16.00	10.55	5.33
	The Consolidated Flour Mills Co., Hutchinson, Kansas				
9509	Wheat Bran & Screenings	Ellsworth	G 14.50	11.00	3.50
			F 18.13	10.06	4.60
	Dominion Flour Mills Ltd.				
9287	Wheat Bran	Pittsfield	G 14.00	10.00	3.00
			F 17.75	8.02	5.90
	Duluth Superior M'g. Co., Duluth, Minn.				
9468	Duluth Imperial Bran	Thorndike	G 15.50	11.75	4.50
			F 17.50	9.65	5.85
	B. A. Eckhart Milling Co., Chicago, Ill.				
9316	Wheat Bran with Recleaned ground wheat screenings NEMR	Old Town	G 14.00	11.00	4.00
			F 15.75	10.75	5.53
	Federal Mill & Elevator Co., Lockport, N. Y.				
9464	Dairy Maid Winter Wheat Bran	Thorndike	G 12.50	12.00	3.50
			F 13.88	8.98	5.04
9400	Dairy Maid Winter Wheat Bran	Newport	F 14.88	10.23	4.84
9302	Lucky Hard Wheat Bran	Bangor	G 15.00	12.00	4.00
			F 16.00	10.98	5.83
	The Gwinn Millling Co., Columbus, Ohio				
9389	Gwinn's Wheat Bran	Skowhegan	G 13.00	13.50	4.00
			F 15.38	8.71	4.64
	J. H. Hale & Sons, Ionia, Mich.				
9471	Flake Bran	Brooks	G 13.50	7.50	3.20
			F 13.38	8.47	4.02
	Heywood Milling Co., Jackson, Mich.				
9344	Pure Wheat Bran	Portland	G 14.00	12.00	3.50
			F 15.63	9.00	5.50
	Highland Milling Co., Highland, Ill.				
9283	Highland Wheat Bran	Belfast	G 14.30	10.00	3.55
			F 15.75	10.46	4.80
	Igleheart Bros., Evansville, Ind.				
9394	Pure Wheat Bran	Skowhegan	G 14.50	10.00	4.00
			F 16.63	8.60	4.22
	Ismert-Hincke Milling Co.				
9309	I. H. Wheat Bran	Bangor	G 14.50	11.00	3.50
			F 16.75	9.12	4.16
	The Kansas Flour Mills Co., Kansas City, Mo.				
9325	Wheat Bran & Wheat Screenings	Portland	G 14.50	11.00	3.50
			F 17.82	10.05	4.90
	The Wm. Kelley Milling Co.				
9353	Wheat Bran	Augusta	G 15.00	11.00	3.50
			F 17.00	9.82	4.87
	Larabee Flour Mills Corp., St. Joseph, Mo.				
9300	Wheat Bran MRS not to exceed 8%	Bangor	G 15.00	10.00	3.50
			F 17.68	10.23	5.07
	H. D. Lee Flour Mills Co.				
9420	Wheat Bran and Screenings	Gardiner	G 14.50	11.00	3.50
			F 17.00	8.14	5.45
	The Mennel Milling Co., Toledo, Ohio				
9453	Fancy Bran	Brunswick	G 15.00	9.50	4.00
			F 15.63	8.82	4.58
	National Feed Co., St. Louis, Mo.				
9500	Wheat Bran	Guilford	G 14.50	10.00	4.00
			F 16.25	9.95	4.44

*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	WHEAT BY-PRODUCTS.				
	BRAN.—Concluded.				
	Northwestern Consolidated Mlg. Co., Minneapolis, Minnesota				
9501	Pure Wheat Bran	Guilford	G* 13.00	13.00	4.00
			F* 16.38	10.06	6.36
	Willis Norton & Co., Inter Ocean Mills, Topeka, Kansas				
9331	Wheat Bran & Screenings	Portland	G 14.50	10.00	3.50
			F 16.25	9.91	5.21
	The Robinson Milling Co.				
9354	Wheat Bran & Screenings	Augusta	G 14.50	11.00	3.50
			F 17.50	9.77	5.23
	The Southwestern Milling Co., Kansas City, Mo.				
9437	Red Turkey Pure Wheat Bran	Bowdoinham	G 14.50	11.80	4.00
			F 16.50	9.75	5.51
	F. W. Stock & Sons, Hillsdale, Mich.				
9288	Bran	Pittsfield	G 14.00	10.00	3.00
			F 16.25	8.29	5.03
	Thompson Milling Co., Lockport, N. Y.				
9425	Angelus Wheat Bran	Augusta	G 15.00	12.00	4.00
			F 15.63	9.73	5.78
	The Toheka Flour Mills Co.				
9352	K. Y. Wheat Bran and Scourings	Augusta	G 14.50	11.00	3.50
			F 16.50	10.59	5.38
	Geo. Urban Milling Co., Buffalo, N. Y.				
9364	Wheat Bran GSNEMR	Bangor	G 14.00	12.00	3.50
			F 14.38	10.05	6.27
	Valley City Milling Co., Grand Rapids, Mich.				
9320	Rowena Wheat Bran GSNEMR	Old Town	G 14.00	10.05	3.50
			F 15.25	10.25	4.80
	Victor Flour Mills Inc., Pittsford, N. Y.				
9406	Victor Spring Wheat Bran	Bucksport	G 16.00	11.00	4.00
			F 17.50	9.44	6.12
	Voight Milling Co., Grand Rapids, Mich.				
9388	Voights Winter Wheat Bran	Skowhegan	G 14.00	10.00	4.00
			F 14.88	10.16	4.77
	Washburn Crosby Co., Minneapolis, Minn.				
9408	Durum Wheat Bran	Bucksport	G 13.00	14.00	4.00
			F 15.25	10.07	6.66
9348	Wheat Bran	Augusta	G 14.00	12.00	4.00
			F 17.25	9.86	5.42
	Wells-Abbott-Nieman Co.				
9393	Pure Wheat Bran	Skowhegan	G 14.50	10.00	3.50
			F 16.75	9.56	5.89
	FEED FLOUR.				
	Bay State Milling Co.				
9508	Longrade Flour	Ellsworth	G 15.20	1.90	3.00
			F 18.38	1.50	3.83
	Hecker-Jones-Jewell Mlg. Co., Buffalo, N. Y.				
9478	Red Dog Flour	Belfast	G 15.50	5.00	3.75
			F 19.38	5.53	5.56
	Shane Bros. & Wilson Co., Minneapolis, Minn.				
9448	Red Dog Wheat Flour	Brunswick	G 16.00	4.00	4.00
			F 20.38	2.48	4.50
	Washburn Crosby Co., Minneapolis, Minn.				
9459	Adrian Red Dog	Brunswick	G 16.00	4.00	4.00
			F 17.50	3.35	4.18

*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Continued.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken		Protein	Fiber	Fat
				%	%	%
	MIDDLINGS.					
	The Allen & Wheeler Co., Troy, Ohio					
9466	Trojan Middlings	Thorndike	G*	15.00	6.00	4.00
			F*	17.63	7.98	5.14
	The Ansted & Burk Co., Springfield, Ohio					
9383	Middlings	Oakland	G	16.25	5.75	4.00
			F	17.50	6.19	5.05
	Barber Milling Co., Minneapolis ,Minn.					
9319	Star Wheat Middlings GSNEMR	Old Town	G	15.00	8.50	5.50
			F	15.75	10.18	5.95
	Bay State Milling Co.					
9494	Bay State White Flour Middlings	Foxcroft	G	14.10	1.90	2.00
			F	18.88	1.75	4.18
	F. H. Brastow & Son, So. Brewer, Me.					
9416	Middlings	So. Brewer	G	16.00	6.00	5.00
			F	17.13	4.56	5.11
	Commander Mill Co., Minneapolis, Minn.					
9512	Commander Wheat Standard Middlings	Ellsworth	G	15.00	11.90	4.50
			F	17.63	8.38	5.49
9488	Durum Wheat Flour Middlings	Dexter	G	17.00	7.50	6.00
			F	17.75	6.03	5.79
	Federal Milling Co., Lockport, N. Y.					
9399	Dairy Maid Winter Wheat Flour Middlings	Newport	G	13.00	10.00	3.00
			F	17.75	5.09	4.75
9436	Lucky Hard Wheat Flour Middlings	Bowdoinham	G	16.50	7.50	5.00
			F	19.38	7.35	6.59
	Heywood Milling Co., Jackson, Mich.					
9435	Pure Middlings	Bowdoinham	G	15.00	8.00	4.25
			F	17.75	6.91	5.89
	Highland Milling Co., Highland, Ill.					
9280	Highland Wheat Middlings	Belfast	G	16.00	8.00	4.00
			F	17.13	6.52	4.75
	Ladish Milling Co.					
9419	Standard Wheat Middlings	Gardiner	G	14.00	13.00	3.50
			F	18.38	8.12	6.73
	The Northwestern Consolidated Mlg. Co., Minneapolis, Minn.					
9335	Wheat Standard Middlings GSNEMR	Portland	G	14.00	9.50	4.00
			F	16.63	9.83	5.84
	Pillsbury Flour Mills Co., Minneapolis, Minnesota					
9359	B. Middlings GSNEMR	Augusta	G	15.00	9.50	4.00
			F	16.25	8.19	5.84
9431	Wheat A Middlings GSNEMR	Augusta	G	16.00	6.00	4.00
			F	18.25	5.10	5.38
	St. Paul Milling Co., St. Paul, Minn.					
9373	Komo Wheat Standard Middlings	Waterville	G	15.00	6.00	4.50
			F	16.83	8.82	5.99
	F. W. Stock & Sons, Hillsdale, Mich.					
9397	Middlings	Skowhegan	G	16.00	7.00	4.00
			F	17.63	6.72	4.93
	David Stott Flour Mills, Detroit, Mich.					
9498	Climax Middlings	Guilford	G	15.00	9.00	4.00
			F	17.13	6.38	5.64
9497	Pennant Middlings	Guilford	G	15.00	9.00	4.00
			F	19.13	8.55	6.37
	Thompson Milling Co., Lockport, N. Y.					
9427	Angelus Wheat Flour Middlings	Augusta	G	15.50	8.30	4.50
			F	16.88	7.61	6.16
	Valley City Milling Co., Grand Rapids, Mich.					
9291	Rowena Wheat Middlings	Pittsfield	G	15.50	7.50	4.50
			F	16.38	5.99	5.39
	Voight Milling Co., Grand Rapids, Mich.					
9444	Voight's Winter Wheat Middlings	Brunswick	G	14.50	10.00	4.00
			F	16.50	7.08	5.28

*These letters indicate respectively guaranteed and found.

Feeding Stuffs—Continued.

Station number	Name and Address of Manufacturer or Jobber and Name of Goods.	Where taken	Protein	Fiber	Fat
			%	%	%
	MIXED FEEDS				
	The Ansted & Burk Co., Springfield, Ohio				
9474	Mixed Feed	Brooks	G* 15.50	6.50	4.00
			F* 16.63	7.99	4.65
	F. H. Brastow & Son, So. Brewer, Me.				
9409	Monarch Wheat Feed	So. Brewer	G 14.00	8.00	4.00
			F 14.75	7.11	5.51
	Chas. M. Cox Co., Boston, Mass.				
9279	Wirthmore Wheat Feed	Belfast	G 15.00	8.00	4.50
			F 17.13	7.18	5.62
	Duluth Superior M'g. Co., Duluth, Minn.				
9377	Boston Mixed Feed	Waterville	G 15.75	10.75	4.50
			F 16.25	9.73	6.76
	Federal Milling Co., Lockport, N. Y.				
9470	Dairy Maid Winter Wheat Mixed Feed	Brooks	G 13.00	9.00	4.00
			F 16.38	8.07	4.80
9401	Dairy Maid Winter Wheat Mixed Feed	Newport	F 16.50	8.80	5.12
9281	Lucky Hard Wheat Mixed Feed	Belfast	G 15.50	10.50	4.50
			F 16.38	8.63	5.82
	J. H. Hale & Sons, Ionia, Mich.				
9472	Acme Mixed Feed	Brooks	G 14.00	7.50	4.00
			F 15.50	7.85	5.51
	Heywood Milling Co., Jackson, Mich.				
9342	Pure Mill Feed	Portland	G 14.00	10.00	3.75
			F 16.50	8.35	5.02
	The Huron Milling Co., Harbor Beach, Mich.				
9332	Jenks Mixed Feed	Portland	G 12.50	11.50	3.50
			F 16.25	11.19	4.26
	Noblesville Milling Co., Noblesville, Ind.				
9297	N. M. Co.'s Mixed Feed	Bangor	G 16.00	8.00	4.00
			F 16.38	8.65	4.73
	Peninsular Flour Mill, Flint, Mich.				
9457	Wheat Mixed Feed	Brunswick	G 14.00	10.00	4.00
			F 16.25	8.51	4.96
	Portland Milling Co.				
9381	Champion Mixed Feed	Oakland	G 13.56	8.47	3.58
			F 16.25	9.25	5.10
	Royal Milling Co., Great Falls, Mont.				
9510	Royal Wheat Mixed Feed	Ellsworth	G 16.00	10.00	4.00
			F 18.75	8.86	6.46
	Russell-Miller M'g. Co., Minneapolis, Minn.				
9289	Occident Wheat Feed	Pittsfield	G 15.00	10.00	4.50
			F 17.75	8.45	6.56
	Sparks Milling Co., Alton, Ill.				
9350	Try Me Mixed Feed	Augusta	G 16.00	9.00	3.50
			F 18.38	7.42	4.61
	F. W. Stock & Sons, Hillsdale, Mich.				
9293	Monarch Fancy Wheat Feed	Pittsfield	G 16.00	10.00	4.00
			F 16.75	7.51	5.65
9278	Superior Wheat Feed and Flour MRS	Belfast	G 16.00	7.00	4.50
			F 17.50	6.20	4.27
	David Stott Flour Mills, Detroit, Mich.				
9499	Stott's Heavy Mixed Feed	Guilford	G 14.00	8.50	3.50
			F 17.63	8.11	5.60
9465	Stott's Honest Mixed Feed	Thorndike	G 14.50	10.50	4.00
			F 17.38	7.62	5.30
	Thompson Milling Co., Lockport, N. Y.				
9428	Angelus Wheat Mixed Feed	Augusta	G 15.50	11.00	4.50
			F 17.13	9.65	5.98

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*These letters indicate respectively guaranteed and found.

FEEDING STUFFS—Concluded.

Station number.	NAME AND ADDRESS OF MANUFACTURER OR JOBBER AND NAME OF GOODS.	Where taken	Protein	Fiber	Fat
			%	%	%
	MIXED FEEDS, Concluded.				
	Washburn Crosby Co., Minneapolis, Minn.				
9347	Wheat Mixed Feed	Augusta	G* 15.00	8.50	4.00
			F* 17.00	7.96	5.11
	Voight Milling Co., Grand Rapids, Mich.				
9445	Voight's Winter Wheat Mixed Feed	Brunswick	G 14.50	10.00	4.00
			F 15.38	8.41	5.06
	The Williams Bros. Co., Kent, Ohio				
9476	Kent Mixed Feed	Brooks	G 16.00	10.00	3.50
			F 18.25	7.51	4.14

*These letters indicate respectively guaranteed and found.

LIST OF INGREDIENTS CLAIMED BY MANUFACTURERS IN COMPOUNDED FEEDS REGISTERED FOR SALE IN 1922.

COMPOUNDED FEEDS FOR HORSES, CATTLE AND SWINE

BRAND, MAKER AND GUARANTEE.

Capital Dairy Ration. E. W. Bailey & Co. Composed of corn gluten feed, linseed oil meal, hominy feed, 43% cottonseed, ground oats, wheat bran, corn meal and ½% salt. Guaranteed 23 per cent protein; 5½% per cent fat and 10 per cent fiber.

Pennant Brand Stock Feed. E. W. Baily & Co. Composed of fine white hominy and oat by-products, ½ of 1% salt. Guaranteed 9 per cent protein; 5 per cent fat and 12 per cent fiber.

Bangor Union Ration. Bangor Farmers' Union. Composed of linseed, gluten, cottonseed, mixed feed, middlings, bran, corn meal, stk. feed, hominy, red Dog, beet pulp, gr. oats. Guaranteed 19-22 per cent protein; 3½-4½ per cent fat and 12 per cent fiber.

Kennebec Dairy Ration. Batchelder Flour Mills Co. Composed of bran, ground oats, corn meal, gluten meal, cotton seed, oil meal, salt. Guaranteed 20.63 per cent protein; 5.19 per cent fat and 7.54 per cent fiber.

Unicorn Dairy Ration. Chapin & Company. Composed of cotton seed meal, linseed meal, corn gluten meal, corn gluten feed, corn oil meal, brewers' grains, wheat bran, hominy meal, salt. Guaranteed 24 per cent protein; 5 per cent fat and 10 per cent fiber.

Advanced Registry Dairy Feed. Clover Leaf Milling Co. Composed of hominy feed, pure old process linseed meal, cocoanut oil meal, corn gluten feed, dried grains from barley malt and corn, wheat bran, wheat middlings, cottonseed meal and one-half of one per cent fine table salt. Guaranteed 25 per cent protein; 5 per cent fat and 10 per cent fiber.

Cloverdale Milk Grains. Clover Leaf Milling Co. Composed of pure old process linseed meal, wheat bran, cocoanut oil meal, cottonseed meal, corn gluten feed, dried grains from barley, malt and corn, cleaned ground and bolted grain screenings; ground and bolted clipped oat by-product, molasses and one-half of one per cent fine table salt. Guaranteed 24 per cent protein; 5 per cent fat and 10 per cent fiber.

Clover Leaf Mills Calf Meal. Clover Leaf Milling Co. Composed of wheat flour, pure old process linseed meal, cottonseed meal, pulverized malt flour, ground oat meal, powdered milk, and one-half of one per cent fine table salt. Guaranteed 25 per cent protein; 5 per cent fat and 7 per cent fiber.

Master Grain Ration. Clover Leaf Milling Co. Composed of cottonseed meal, pure old process linseed meal, cocoanut oil meal, corn gluten feed, wheat bran, wheat middlings, dried grains from barley malt and corn, molasses, and one-half of one per cent fine table salt. Guaranteed 24 per cent protein; 5 per cent fat and 10 per cent fiber.

Peerless Milk Ration. Clover Leaf Milling Co. Composed of cottonseed meal, pure old process linseed meal, cocoanut oil meal, corn gluten feed, wheat bran, dried grains from barley malt and corn, cleaned ground and bolted grain screenings, ground and bolted clipped oat by-product, molasses and one-half of one per cent fine table salt. Guaranteed 20 per cent protein; 4.50 per cent fat and 12 per cent fiber.

Charlestock Feed. Chas. M. Cox Co. Composed of oat feed (oat meal mill by-products, oat shorts, oat middlings, oat hulls), hominy or corn meal, linseed oil meal and ½ of 1 per cent salt. Guaranteed 10 per cent protein; 4 per cent fat and 14 per cent fiber.

Paragon Dairy Feed. Chas. M. Cox Co. Composed of cottonseed meal, linseed oil meal, corn gluten feed, oat feed, (oat meal mill by-products, oat middlings, oat shorts, oat hulls) ground corn and ground screenings, wheat bran (with ground screenings not to exceed mill run) and not over 1 per cent salt. Guaranteed 22 per cent protein; 4 per cent fat and 14 per cent fiber.

Wirthmore Balanced Ration for Milch Cows. Chas. M. Cox Co. Composed of cottonseed meal, linseed meal, corn gluten feed, wheat middlings, wheat bran (not exceeding mill run screenings), corn distillers grains, choice dried grains, hominy or corn meal and not over ¾ of 1% salt. Guaranteed 25 per cent protein; 5.5 per cent fat and 11 per cent fiber.

Wirthmore Stock Feed. Chas. M. Cox Co. Composed of ground barley, ground oats, ground hominy meal, ground corn, oat meal by-products (oat middlings, oat shorts, oat hulls) and ½ of 1% salt. Guaranteed 9 per cent protein; 4 per cent fat and 9½ per cent fiber.

Easterns 25 Dairy Ration. Eastern Grain Co. Composed of choice cottonseed meal, wheat bran, wheat middlings, cocoanut oil meal, corn gluten feed, corn gluten meal, old process linseed-oil meal, dried beet pulp, ½ of 1% salt. Guaranteed 25 per cent protein; 5 per cent fat and 12 per cent fiber.

Easterns 24 Dairy Ration. Eastern Grain Co. Composed of choice cottonseed meal, wheat bran, wheat middlings, cocoanut oil meal, corn gluten feed, corn gluten meal, cane molasses, old process linseed-oil meal, alfalfa meal, ½ of 1% salt. Guaranteed 24 per cent protein; 5 per cent fat and 12 per cent fiber.

Easterns White Stock Feed. Eastern Grain Co. Composed of corn feed meal, wheat middlings, hominy feed, oat meal mill by-products (oat midds. oat hulls, oat shorts), ground barley, ground oats. Guaranteed 10 per cent protein, 3 per cent fat and 10 per cent fiber.

Eshelman's Calf Meal. John W. Eshelman & Sons. Composed of cooked and baked wheat feed, old process linseed meal, wheat middlings, wheat flour, oat meal, ground kaffir corn, blood meal, pure ground flaxseed 2%. Guaranteed 16 per cent protein; 3 per cent fat and 3 per cent fiber.

Eshelman's 85 Horse Feed. John W. Eshelman & Sons. Composed of cracked corn, crushed oats, cane molasses, alfalfa meal, ½ of 1% salt. Guaranteed 9 per cent protein, 3 per cent fat and 12 per cent fiber.

Eshelman's Hog meal. John W. Eshelman & Sons. Composed of guaranteed 10% digester tankage and dried buttermilk, corn feed meal, wheat middlings, wheat bran, hominy feed, old process linseed meal 2%, charcoal 2%. Guaranteed 16 per cent protein, 5 per cent fat and 6 per cent fiber.

Eshelman's 24 Dairy Feed. John W. Eshelman & Sons. Composed of choice cottonseed meal, wheat bran, wheat middlings, cocoanut oil meal, corn gluten feed, corn gluten meal, cane molasses, old process linseed meal, alfalfa meal, ½ of 1 per cent salt. Guaranteed 24 per cent protein; 5 per cent fat and 12 per cent fiber.

Grandin's Milk Maker. D. H. Grandin Milling Co. Composed of linseed oil meal, cottonseed meal, cocoanut oil meal, wheat bran, wheat middlings, corn meal, corn feed meal, hominy feed, oat middlings, beet pulp and one-half of one per cent of salt. (Wheat bran and wheat middlings may contain ground screenings not exceeding mill run.) Guaranteed 20 per cent protein; 5 per cent fat and 12 per cent fiber.

Grandin's Stock Food. D. H. Grandin Milling Co. Composed of corn meal, corn feed meal, hominy feed, wheat middlings, ground barley, oat meal mill by-products, (Oat middlings, oat hulls oat shorts) and one-half of one per cent salt. (Wheat middlings may contain ground screenings not exceeding mill run.) Guaranteed 9 per cent protein; 5 per cent fat and 12 per cent fiber.

Grandin's 24% Balanced Dairy Ration. D. H. Grandin Milling Co. Composed of distillers' dried grains, cottonseed meal, cocoanut oil meal, linseed oil meal, corn gluten feed, wheat bran, wheat middlings, hominy meal, and one-half of one per cent of salt. Guaranteed 24 per cent protein; 5 per cent fat and 10 per cent fiber.

Grandin's 12 Twin Six 12 Dairy Feed. D. H. Grandin Milling Co. Composed of linseed oil meal, cottonseed meal, cocoanut oil meal, corn gluten feed, wheat bran, wheat middlings, corn meal, corn feed meal, hominy feed, oat middlings, alfalfa meal, and one-half of one per cent of salt. Guaranteed 22 per cent protein; 5 per cent fat and 12 per cent fiber.

Gwinn's Dairy Feed. Gwinn Milling Co. Composed of wheat bran and middlings, with screenings not exceeding mill run. Guaranteed 14 per cent protein; 4 per cent fat and 11 per cent fiber.

Orono Dairy Ration. J. B. Ham Co. Composed of wheat bran, gluten feed, linseed oil meal, cottonseed meal, salt, ground oats, corn meal. Guaranteed 20 per cent protein; 4.5 per cent fat and 10 per cent fiber.

Homestead Dairy Feed. Illinois Feed & Elevator Co. Composed of wheat bran, wheat middlings, distillers' dried grains, dried beet pulp, corn feed meal, hominy feed, cottonseed meal, linseed meal, corn gluten feed, ½% salt, calcium carbonate. Guaranteed 22 per cent protein; 5 per cent fat and 10 per cent fiber.

Homestead Stock Feed. Illinois Feed & Elevator Co. Composed of whole ground corn, hominy feed, whole ground oats, whole ground barley, whole ground wheat, oat mill by-products (oat middlings, oat flour and oat hulls). Guaranteed 9 per cent protein; 3½ per cent fat and 9 per cent fiber.

Badger Stock Feed. Chas. A. Krause Milling Co. Composed of Badger hominy feed, oat meal mill by-product, (oat hulls, oat middlings and oat shorts) and salt. Guaranteed 10 per cent protein; 3.25 per cent fat, and 10 per cent fiber.

Larro. The Larrowe Milling Co. Composed of cottonseed meal, corn gluten feed, old process linseed oil meal, standard wheat bran, standard wheat middlings, dried beet pulp and ¾ of 1% salt. Guaranteed 20 per cent protein; 3½ per cent fat and 14 per cent fiber.

Elm City Dairy Ration. Merrill & Mayo Co. Composed of corn distillers' dried grains, linseed oat meal, cotton seed meal, malt sprouts, wheat bran, wheat middlings, gluten feed, hominy feed and ½% salt. Guaranteed 25 per cent protein; 6 per cent fat and 11 per cent fiber.

Elm City Stock Feed. Merrill & Mayo Co. Composed of hominy feed, corn meal, oat hulls, oat shorts, oat middlings, oil meal, C. S. meal, wheat bran, ground barley and oats, salt. Guaranteed 10 per cent protein; 4 per cent fat and 12 per cent fiber.

Osota Feed. National Milling Co. Composed of wheat bran and wheat middlings with ground screenings not exceeding mill run. Guaranteed 15 per cent protein; 4.50 per cent fat and 10 per cent fiber.

New England Stock Feed. New England Grain Co. Composed of ground barley, ground oats, ground hominy meal, ground corn, ground shorts, oat hulls, ½ of 1% of salt. Guaranteed 9 per cent protein; 4 per cent fat and 9.5 per cent fiber.

Stevens "44" Dairy Ration. The Park & Pollard Co. Inc. Composed of linseed oil meal, cottonseed meal, corn gluten feed, cocoanut oil meal, pea meal, corn distillers dried grains, brewers dried grains, corn meal, calcium carbonate, salt, wheat bran with mill run of screenings. Guaranteed 24 per cent protein; 5 per cent fat and 14 per cent fiber.

Stevens Milkade Calf Meal. The Park & Pollard Co., Inc. Composed of ground malt, old process linseed oil meal, wheat bran, wheat flour, cocoanut oil meal, bone meal, (1%), Rice polish, cocoa shell meal, wheat middlings, sesame oil meal, blood flour (3%), and a small percentage of calcium carbonate, ground Fennugreek, ground annis and salt. Guaranteed 20 per cent protein; 8 per cent fat and 7½ per cent fiber.

Iowa Stock Feed. Purity Oats Co. Composed of wheat middlings, corn meal, hominy feed, brewers' dried grains, corn gluten feed, oat meal mill by-products (oat shorts, oat hulls, oat middlings) and 1% table salt. Guaranteed 10 per cent protein; 4 per cent fat and 12.75 per cent fiber.

Big "Q" Dairy Ration. The Quaker Oats Co. Composed of hominy feed, yellow hominy feed, cottonseed meal, corn distillers' grains, corn gluten feed, old process linseed oil meal, wheat bran & wheat middlings (with ground wheat screenings not exceeding mill run) molasses, oatmeal mill by-product (oat middlings, oat shorts, oat hulls) 1% calcium phosphate, 1% salt. Guaranteed 21 per cent protein; 4.5 per cent fat and 12 per cent fiber.

Buckeye Feed. The Quaker Oats Co. Composed of wheat mixed feed (with ground wheat screenings not exceeding mill run) rye middlings. Guaranteed 15.50 per cent protein; 4.50 per cent fat and 11 per cent fiber.

Schumacher Feed. Quaker Oats Co. Composed of ground corn, hominy feed, yellow hominy feed, ground barley, cottonseed meal, old process linseed oil meal, low grade wheat flour, wheat bran & wheat middlings (with wheat screenings not exceeding mill run) oat meal mill by-products (oat middlings, oat shorts, oat hulls) ¾ of 1% salt. Guaranteed 10 per cent protein; 3.25 per cent fat and 12 per cent fiber.

Schumacher Feed Sugared. The Quaker Oats Co. Composed of ground corn, hominy feed, yellow hominy feed, ground barley cottonseed meal, old process linseed oil meal, low grade wheat flour, wheat bran and wheat middlings (with ground wheat screenings not exceeding mill run) molasses, oat meal mill by-product (oat middlings, oat shorts, oat hulls) ¾ of 1% salt. Guaranteed 10 per cent protein, 3.25 per cent fat and 12 per cent fiber.

Ryde's Cream Quality Calf Meal. Ryde & Co. Composed of wheat flour, linseed oil meal, recleaned cottonseed meal, cocoanut oil meal, beans and lentils, hominy feed, locust bean, meal, blood flour, ground flaxseed, malt flour, cocoa shell meal, dried milk, Fenugreek Anise, calcium carbonate, salt. Guaranteed 25 per cent protein; 5 per cent fat and 6¾ per cent fiber.

Gold Mine Feed. Sheffield-King Milling Co. Composed of bran, shorts, low grade flour, all wheat product and pulverised wheat screenings. Guaranteed 15 per cent protein; 4.50 per cent fat and 10 per cent fiber.

Stott's Winner Feed. David Stott Flour Mills. Composed of corn, corn feed meal, oats, oat meal by-products (oat hulls and chaff) salt. Guaranteed 8.5 per cent protein; 3.5 per cent fat and 10 per cent fiber.

Ubiko Grains. The Ubiko Milling Co. Composed of corn distillers' dried grains, choice cottonseed meal, old process linseed meal,. white wheat middlings, winter wheat bran, hominy meal, corn germ meal, corn gluten feed, brewers' dried grains, one-half per cent of fine table salt. Guaranteed 24 per cent protein; 5 per cent fat and 10 per cent fiber.

Creamery Cow Feed. Wiscasset Grain Co. Composed of ground corn, oats and barley with cottonseed meal, linseed oil meal, gluten, wheat bran, wheat middlings and salt. Guaranteed 20 per cent protein; 5 per cent fat and 10 per cent fiber.

COMPOUNDED FEEDS FOR POULTRY

Wirthmore Buttermilk Mash Feed Fish & Meat Scraps. Chas. M. Cox Co. Composed of pure dried buttermilk, dried milk albumen, ground oats, barley, corn wheat, bran, wheat middlings (not exceeding mill run screenings), corn gluten feed, beet pulp, rolled oats, choice fine ground beef scraps, fish meal, linseed meal, buckwheat and about ¾ of 1% salt. Guaranteed 20 per cent protein; 4 per cent fat and 8½ per cent fiber.

Wirthmore Growing Feed with Dried Buttermilk & Beef Scraps. Chas. M. Cox Co. Composed of pure dried buttermilk, dried milk albumen, bone meal, ground wheat, corn, oats, barley, peas, milo maize, wheat bran, wheat middlings (not exceeding mill run screenings) red dog flour and choice fine ground beef scraps. Guaranteed 15 per cent protein; 4½ per cent fat and 4½ per cent fiber.

Dow's Favorite Poultry Meal. John C. Dow Company. Composed of dried meat, bone, Fenugreek seed and cottonseed meal. Guaranteed 30 per cent protein; 10 per cent fat and 3 per cent fiber.

Eastern's Laying Egg Mash. Eastern Grain Co. Composed of dried buttermilk, meat and fish scraps, wheat middlings, corn feed meal, wheat bran, corn gluten feed, ground oats, ground barley, hominy feed, old process linseed-oil meal, alfalfa meal. Guaranteed 20 per cent protein; 5 per cent fat and 7 per cent fiber.

Eshelman's Growing Mash. John W. Eshelman & Sons. Composed of guaranteed 10% dried buttermilk, meat and fish scrap, wheat middlings, corn feed meal, wheat bran, corn gluten feed, ground oats, ground barley, hominy feed, 2% old process linseed meal, 1% alfalfa meal. Guaranteed 16 per cent protein; 4 per cent fat and 8 per cent fiber.

Eshelman's Laying Mash. John W. Eshelman & Sons. Composed of guaranteed 20% dried buttermilk, meat and fish scraps, wheat middlings, corn feed meal, wheat bran, corn gluten feed, ground oats, ground barley, hominy feed, 2% old process linseed meal, 1% alfalfa meal. Guaranteed 20 per cent protein; 5 per cent fat and 7 per cent fiber.

Grandin's Growing Feed. D. H. Grandin Milling Co. Composed of ground meat and bone, bone meal, dried buttermilk, corn gluten feed, wheat bran wheat middlings, corn meal, corn feed meal, hominy feed, ground oats, ground scratch feed screenings consisting of (corn, wheat barley, kaffir corn, milo maize and buckwheat) and calcium carbonate. (Wheat bran and Wheat middlings may contain ground screenings not exceeding mill run). Guaranteed 14 per cent protein; 4 per cent fat and 8 per cent fiber.

Greene's Poultry Food. Greene Chick Feed Co. Composed of meat bone and salt. Guaranteed 35 per cent protein and 5 per cent fat.

Orono Dry Mash. J. B. Ham Co. Composed of corn meal, ground oats, wheat bran, wheat middlings, linseed meal, meat scraps charcoal, alfalfa. Guaranteed 17 per cent protein; 4.5 per cent fat and 12 per cent fiber.

Dirigo Egg Mash. Oscar Holway Co. Composed of alfalfa meal, bran, middlings, wheat meal, corn feed meal, ground corn, linseed meal, meat scraps and salt ½ of 1%. Guaranteed 16 per cent protein; 3 per cent fat and 10 per cent fiber.

New England Egg Mash. New England Grain Co. Composed of linseed oil meal, corn meal, gr. oats, meat meal, meat scraps, wheat, bran, middlings, alfalfa meal, gluten. Guaranteed 18 per cent protein; 4 per cent fat and 10 per cent fiber.

Growing Feed. Park & Pollard Co. Composed of ground: corn, wheat, oats, barley, meat and bone meal, wheat bran with mill run of screenings, wheat middlings, dried buttermilk, calcium carbonate and salt. Guaranteed 10 per cent protein; 1½ per cent fat and 8 per cent fiber.

Lay or Bust Dry Mash. Park & Pollard Co. Composed of ground: corn, wheat, wheat screenings, oats, barley, kaffir corn, buckwheat, alfalfa, fish, meat, bone, wheat bran with mill run screenings, wheat middlings, calcium carbonate, salt, dried buttermilk. Guaranteed 18 per cent protein; 1½ per cent fat and 12 per cent fiber.

Leghorn Lay or Bust Special. Park & Pollard Co. Composed of ground: corn, wheat, wheat screenings, barley, oats, kaffir corn, buckwheat, wheat bran, wheat middlings, alfalfa, fish, meat, bone, calcium carbonate, salt, dried buttermilk. Guaranteed 21 per cent protein; 1½ per cent fat and 10 per cent fiber.

Full-O-Pep Dry Mash. The Quaker Oats Co. Composed of hominy feed, yellow hominy feed, corn gluten feed, oat meal, cottonseed meal, wheat bran, and middlings (with ground wheat screenings not exceeding mill run) bone meal, fish meal, meat scraps, alfalfa meal, ground grain screenings from wheat. Guaranteed 20 per cent protein; 4 per cent fat and 10 per cent fiber.

Full-O-Pep Growing Mash. The Quaker Oats Co. Composed of hominy feed, yellow hominy feed, corn gluten feed, wheat bran and wheat middlings (with ground wheat screenings not exceeding mill run) oat meal, fish meal, bone meal, meat scraps, ground puffed wheat, alfalfa meal. Guaranteed 17 per cent protein, 5.25 per cent fat and 9 per cent fiber.

COMPOUNDED FEEDS FOR POULTRY—SCRATCH FEEDS.

Humpty Dumpty Scratch Feed. The Ansted & Burk Co. Composed of wheat, corn, kaffir corn, milo maize, buckwheat, barley, sunflower seed and wheat screenings. Guaranteed 11 per cent protein; 3 per cent fat and 4 per cent fiber.

Clover Leaf Mills Developing Feed. Clover Leaf Milling Co. Composed of wheat, hulled oats, kaffir corn, milo maize and cracked corn. Guaranteed 10 per cent protein; 2.50 per cent fat and 5 per cent fiber.

Peerless Scratch Grains. Clover Leaf Milling Co. Composed of wheat, cracked corn, kaffir corn, barley, oats, buckwheat, and sunflower seed. Guaranteed 10 per cent protein; 2.50 per cent fat and 5 per cent fiber.

Wirthmore Gritless Intermediate Chick Feed. Chas. M. Cox Co. Composed of cracked wheat, yellow corn, peas, kaffir corn, milo maize, white corn and hulled oats. Guaranteed 11 per cent protein; 3 per cent fat and 3.5 per cent fiber.

Wirthmore Scratch Feed. Chas. M. Cox Co. Composed of wheat, kaffir corn, sunflower seed, buckwheat, barley, oats, cracked corn and milo maize. Guaranteed 11 per cent protein; 3 per cent fat and 5 per cent fiber.

Eastern's Big Chick Feed. Eastern Grain Co. Composed of cracked corn, kaffir corn, wheat, hulled oats, buckwheat. Guaranteed 10 per cent protein; 3 per cent fat and 3 per cent fiber.

Eastern's Screened Scratch Feed. Eastern Grain Co. Composed of cracked corn, wheat, kaffir corn, barley buckwheat, oats, sunflower seed, recleaned grain screenings from wheat. Guaranteed 9 per cent protein; 3 per cent fat and 4 per cent fiber.

Imperial Scratch Feed. John W. Eshelman & Sons. Composed of cracked corn, kaffir corn, barley, wheat, buckwheat, oats, ½ of 1% sunflower seed, recleaned grain screenings from wheat. Guaranteed 9 per cent protein; 3 per cent fat and 4 per cent fiber.

Grandin's Screened Scratch Feed. D. H. Grandin Milling Co. Composed of wheat, cracked corn, kaffir corn, milo maize, barley, buckwheat and sunflower seed. Guaranteed 10 per cent protein; 2.5 per cent fat and 5 per cent fiber.

Dirigo Scratch Feed. Oscar Holway Co. Composed of wheat, kaffir corn, barley, cracked Indian corn, buckwheat and sunflower seed. Guaranteed 10 per cent protein; 2.50 per cent fat and 5 per cent fiber.

Homestead Scratch Feed. Illinois Feed & Elevator Co. Composed of cracked corn, wheat, buckwheat, barley, milo maize, and sunflower seed. Guaranteed 9 per cent protein; 3 per cent fat and 5 per cent fiber.

Illinois Fancy Scratch Feed. Illinois Feed & Elevator Co. Composed of cracked corn, wheat, barley, buckwheat, milo maize, sunflower seed. Guaranteed 9 per cent protein; 3 per cent fat and 5 per cent fiber.

Elm City Scratch Feed. Merrill & Mayo Co. Composed of corn, wheat, barley, oats, kaffir corn, buckwheat, sunflower seed. Guaranteed 10 per cent protein; 2.50 per cent fat and 5 per cent fiber.

Intermediate Chick Feed. The Park & Pollard Co. Composed of cracked corn, wheat, buckwheat, hulled oats, millet seed, kaffir corn, milo maize, hulled barley. Guaranteed 10 per cent protein; 1½ per cent fat and 5 per cent fiber.

Pontiac Scratch Feed. The Park & Pollard Co. Composed of cracked corn, wheat, buckwheat, barley, oats, kaffir corn, and milo. Guaranteed 10 per cent protein; 1½ per cent fat and 5 per cent fiber.

Red Ribbon Scratch Feed. The Park & Pollard Co. Composed of cracked corn, wheat, buckwheat, barley, oats, kaffir corn, milo maize, and sunflower seed. Guaranteed 10 per cent protein; 1½ per cent fat and 5 per cent fiber.

Ful-O-Pep Scratch Grains. The Quaker Oats Co. Composed of cracked corn, whole barley, whole wheat, whole kaffir corn, whole milo maize, buckwheat, ½ of 1% sunflower seed. Guaranteed 9 per cent protein; 2 per cent fat and 5 per cent fiber.

October, 1922

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

CHEMISTS.

James M. Bartlett, Chief

Elmer R. Tobey, Associate **C. Harry White, Assistant**

Official Inspections

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COMMERCIAL FERTILIZERS, 1922

James M. Bartlett.

The Commissioner of Agriculture is the executive of the law regulating the sale of fertilizers in Maine. It is the duty of the Director of the Maine Agricultural Experiment Station to make the analyses of the samples collected by the Commissioner, and to publish the results of the analyses together with such additional information as may seem advisable.

Note: All correspondence relative to the inspection laws and requests for copies of the laws should be addressed to the Division of Inspections, Department of Agriculture, Augusta, Maine.

THE CHIEF POINTS OF THE FERTILIZER LAW.

A commercial fertilizer is any material used for fertilizing purposes, the price of which exceeds ten dollars a ton. Each package or lot shall carry a plainly printed statement giving: the number of net pounds in the package; the name brand or trade mark; the name and principal address of maker; and a "chemical analysis stating the minimum percentage of nitrogen, available as plant food, present as nitrates, ammonia salts or organic nitrogen, of potash soluble in water, of phosphoric acid in available form, soluble and reverted, and of total phosphoric acid." All fertilizers must be registered with the Commissioner of Agriculture before being offered for sale.

A fertilizer is misbranded if: it fails to bear all of the statements named above; if these statements are not in accord with the certificate filed with the Commissioner of Agriculture; and if the registration fee has not been paid.

A fertilizer is adulterated "First, if its weight, composition quality, strength or purity do not conform in each particular to the claims made upon the affixed guaranty. Second, if it contains any material deleterious to growing plants. Third, if it is found to contain any pulverized leather, hair, ground hoofs, horns, wool waste, peat, garbage tankage, cyanamide, or any nitrogenous ingredients derived from any inert material whatsoever, unless the same has been so treated as to be available as plant food as determined by the methods adopted by the association of official agricultural chemists, without an explicit printed statement of the fact, conspicuously affixed to the package of such fertilizer and accompanying and going with every lot or package of the same, in which fertilizer the above named materials aid in making up the required or guaranteed analysis."

DESCRIPTION OF TABLES.

The tables following a brief description give the analyses of fertilizers collected by the Division of Inspections of the Department of Agriculture in the spring of 1922.

The reports of each brand appear upon two pages. The left hand page carries the number of the fertilizer, the name of the maker, his place of business, the name of the brand and the town where the sample was taken. The right hand page repeats the number of the sample and gives the detailed numerical results of the chemical examination. The first column of the table gives the station number of the sample, the second column the per cent of water in the goods when analyzed.

Water. The amount of water the goods carry has a marked effect upon the amount of the other constituents. Usually when the goods leave the factory they carry about 9 per cent of water. If they are exposed to a moist air they are likely to take up water. If kept in a very dry place they will lose water. For the most part there is a greater tendency to absorb than to lose water. In the first instance the goods will increase in weight and in the second lose in weight. A change in water content effects the analysis. A loss of water increases the percentages of nitrogen, phosphoric acid and potash while an increase of water reduces them. A sample carrying less than 9 per cent of water will likely overrun its guaranteed analysis and a sample containing much more than 9 per cent of water is likely to fall short in one or more constituents. It is unfortunate that the difficulty of transporting suitable accurate scales from one place to another prevents the inspector actually weighing the packages from which his samples are drawn. No one thing would add more of value to fertilizer inspection than the actual weighing of packages which are sampled.

If the weight of the goods at time of sampling as compared with the claimed weight was known a simple calculation would show the actual content of the fertilizer when it left the factory. When the sample is taken it is at once put into a tightly sealed jar and kept sealed until the analysis is made. So the column headed water indicates the amount carried at the time the inspector drew the sample.

Phosphoric acid. In fertilizers phosphoric acid is usually present in three forms, water soluble, weak organic acid soluble, and insoluble. The water soluble and weak organic acid soluble together make up the available phosphoric acid. Other than that the water soluble is a little better distributed in the soil there is no choice from the standpoint of plant growth between the water soluble and the weak organic acid soluble, for very soon after its introduction into the soil the water soluble is changed to organic acid soluble form.

The insoluble phosphoric acid is readily found by subtracting the available phosphoric acid found from the total found. Such small amounts as 1 per cent of insoluble phosphoric acid in the amounts in which fertilizers are applied per acre have no appreciable agricultural value.

Potash. The column marked potash found gives the per cent of water soluble potash the goods contained. The fertilizers collected this season contained more nearly normal potash both in quantity and quality than at any time since the German supply was shut off. Only a few brands contained any borax and those contained only tolerated amounts.

Nitrogen. Three columns are devoted to nitrogen, in the tables. Nitrogen may be present in a fertilizer as mineral or organic or both mineral and organic. Mineral nitrogen is usually present as nitrate of soda or sulphate of ammonia. These are the most available forms of nitrogen used, therefore it is desirable that a part of the nitrogen present be in the mineral form. The nitrogen present as nitrate and ammonia was determined and will be found in the column so marked. The column marked active nitrogen represents the sum of the mineral nitrogen, the water soluble organic nitrogen, and that part of the insoluble organic found available by the alkaline permanganate method. This is all considered readily available nitrogen. The column marked total nitrogen gives the per cent of all the nitrogen found and is comparable with the manufacturers' guaranty, but the other columns furnish much valuable information as to the quality of nitrogen present.

FERTILIZER TROUBLES

The fertilizers collected and examined in 1922 conformed closely to their guarantees in nearly all instances, were practically free from boron and no other materials injurious to plants were detected. The organic nitrogen was tested by the alkaline per manganate method and found to be of good quality. Mineral nitrogen namely, nitrate-soda and sulphate of ammonia, was cheaper this year than organic and consequently large amounts were used in the high grade goods and some brands carried as much as 75% of the nitrogen in that form. These salts are very soluble in water and it was not unusual for this class of goods to contain 60 to 75% of their nitrogen in water soluble form.

About harvest time many complaints of poor looking fields or poor yields of potatoes were received. The trouble was attributed in most cases to the ferilizer. In several instances samples of the fertilizer were obtained and examined but in every case the goods were found to be practically up to the guarantee and free from injurious amounts of boron. A description of the appearance of the fields seemed to indicate a lack of plant food, particularly nitrogen, in the latter part of the season, although a ton of high grade fertilizer was used per acre in most cases. Early in June, Maine was visited by very heavy rains, about 5 inches of water falling in twenty-four hours. Many fields were flooded and the soil badly washed. It is a common practice to put all the fertilizer on at the time of planting and it is highly probable that when a fertilizer was used carrying 75% of its nitrogen in soluble form and all applied when the seed was put in the ground, that the greater part of the soluble nitrogen was leached down out of reach of the potato plant roots or washed away leaving the plants nothing with which to complete their growth. This seems to be about the only explanation for the apparent lack of plant food when large amounts of high grade fertilizer were applied. As high grade organic nitrogen has been getting higher in price for the past ten years until now it is 25% higher than mineral nitrogen from nitrate of soda and sulphate of ammonia which is entirely soluble in water it is not probable that fertilizer manufacturers will make high grade fertilizer carrying much less of its nitrogen in soluble form than was found this season. Farmers should therefore take the matter of water soluble nitrogen into consideration and guard against loss by heavy rains early in the season by applying only a part of the fertilizer at the time of planting and the remainder later on. Not every season, of course, will the rain fall be sufficient to cause loss but as one cannot correctly prophecy what the weather will be and the increased expense of applying the fertilizer in two or three applications instead of one is but small, it is much safer not to take the risk. There is also less danger of fertilizer injury to the seed if only a part of the fertilizer is put on at time of planting.

DIRECTIONS FOR HOME MIXING OF FERTILIZERS.

The Station is frequently asked for directions for making a fertilizer of a required formula, the chemicals or materials for making the same being given. The following general rule can be used in all cases for mixing any amount of fertilizer.

Rule. The number of pounds of fertilizer wanted multiplied by the per cent (expressed in hundredths) of the ingredient wanted and the product divided by the per cent (expressed in hundredths) of that ingredient in the material used gives the weight of that material to take.

EXAMPLE I.

To make a ton (2000 lbs.) of fertilizer having 4% nitrogen, 8% available phosphoric acid and 6% of water soluble potash, from nitrate of soda carrying 15% nitrogen, tankage containing 6% nitrogen and 6% available phosphoric acid, acid phosphate carrying 16% available phosphoric acid, and muriate of potash carrying 50% water soluble potash. One per cent of the nitrogen is wanted as nitrate from the nitrate of soda; then, according to the rule, the following amounts of each material to take can be calculated as follows:

2000 lbs. × .01 = 20 lbs. ÷ .15 = 133.33 lbs. of nitrate of soda
2000 lbs. × .03 = 60 lbs. ÷ .06 = 1000.00 lbs. of tankage
2000 lbs. × .05 = 100 lbs. ÷ .16 = 625.00 lbs. acid phosphate
2000 lbs. × .06 = 120 lbs. ÷ .50 = 240.00 lbs. muriate of potash

Total 1998.33 lbs.

This formula it will be seen has 80 lbs. of nitrogen, 160 lbs. available phosphoric acid and 120 lbs. of actual potash in a ton. In case of the phosphoric acid the 1000 lbs. of tankage taken to get the 3% nitrogen required furnishes 60 lbs. of available phosphoric acid, that is 1000 lbs. x .06 = 60 lbs. so only enough acid phosphate to furnish 100 lbs. or 5% available has to be added, the other 3% coming from the tankage. In this case a filler does not have to be used, the total weights being very near a ton. If higher grade materials were used, that is, if a part of the tankage were replaced by sulphate of ammonia or dried blood, 200 or 300 pounds of filler might be necessary to make up the ton.

EXAMPLE II.

To make 1000 lbs. of fertilizer carrying 5% of nitrogen, 8% of available phosphoric acid and 4% water soluble potash from nitrate of soda containing 15% of nitrogen, sulphate of ammonia containing 20% of nitrogen, dried blood containing 12% of nitrogen, acid phosphate containing 16% of available phosphoric acid and muriate of potash containing 48% of water soluble potash. One per cent of nitrogen is wanted as nitrate and one per cent as sulphate of ammonia. Then according to the rule we would have

1000 × .01 = 10 lbs. ÷ .15 = 66.66 lbs. of nitrate of soda
1000 × .01 = 10 lbs. ÷ .20 = 50.00 lbs. of sulphate of ammonia
1000 × .03 = 30 lbs. ÷ .12 = 250.00 lbs. of dried blood
1000 × .08 = 80 lbs. ÷ .16 = 500.00 lbs. of acid phosphate
1000 × .04 = 40 lbs. ÷ .48 = 83.34 lbs. of muriate of potash

950.00
filler 50.00

1000.00 lbs.

TRADE VALUES

For several years this Station has not published trade values of fertilizers. The principal reason why such values have not been published is because prices have fluctuated so that by the time the fertilizers are analyzed and the results published the prices obtained when the goods were collected would not furnish true values. The only way to get accurate trade values is to get quotations from dealers of chemicals at the time one wishes to purchase and apply them to the tables of analyses given in the bulletin. Fertilizer materials are usually quoted at ton prices with a per cent guaranty. That is, if nitrate of soda were quoted at $60 per ton with a guaranty of 15% nitrogen a ton would carry 300 lbs. of nitrogen and the price per pound for the nitrogen would be $60 ÷ 300 = 20 cts. The pound price of available phosphoric acid in acid phosphate or water soluble potash in potash salts can be found in the same manner. Fertilizer materials are sometimes quoted at unit prices. In the fertilizer business a unit is 20 lbs. therefore if the unit price is given one has only to divide it by 20 to get the pound price.

Nitrogen is often spoken of and quoted as ammonia by the fertilizer trade. Ammonia is a compound of nitrogen and hydrogen and a pound of ammonia contains .8235 lb. of nitrogen therefore the pound price of ammonia should be divided by .8235 to get the pound price of nitrogen.

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
	AMERICAN AGRICULTURAL CHEMICAL CO., NEW YORK CITY.	
6194	Aroostook Potato Manure	Bangor
6257	Aroostook Potato Manure	Portland
6201	Bradley's AA Potato Grower	Searsport
6211	Bradley's AA Potato Grower	Portland
6188	Bradley's Blood, Bone and Potash	Bangor
6394	Bradley's Blood, Bone and Potash	Bridgton
6184	Bradley's Complete Manure for Potatoes & Vegetables	Bangor
6276	Bradley's Complete Manure for Potatoes & Vegetables	Lee
6247	Bradley's Complete Manure for Top Dressing, Grass and Grain	Portland
6480	Bradley's Complete Manure for Top Dressing, Grass and Grain	Calais
6190	Bradley's Complete Manure with 10% Potash	Bangor
6471	Bradley's Complete Manure with 10% Potash	Calais
6185	Bradley's Corn Phosphate	Bangor
6468	Bradley's Corn Phosphate	Calais
6197	Bradley's Eclipse Phosphate	Bangor
6472	Bradley's Eclipse Phosphate	Calais
6182	Bradley's Northland Potato Grower	Bangor
6256	Bradley's Northland Potato Grower	Portland
6217	Bradley's Potato Fertilizer	Portland
6187	Bradley's Potato Fertilizer	Bangor
6189	Bradley's Potato Manure	Bangor
6470	Bradley's Potato Manure	Calais
6183	Bradley's XL Superphosphate of Lime	Bangor
6469	Bradley's XL Superphosphate of Lime	Calais
6252	Clark's Cove Bay State Fertilizer GG	Portland
6233	Clark's Cove Potato Fertilizer	Portland
6269	Complete Manure with 10% Potash	Portland
6255	Complete Orchard Fertilizer	Portland
6156	Complete Potato Mixture	Bangor
6245	Complete Potato Mixture	Portland
6248	Crocker's Ammoniated Corn Phosphate	Portland
6266	Crocker's New Rival Ammoniated Superphosphate	Portland
6232	Crocker's Potato, Hop and Tobacco Fertilizer	Portland
6260	Darling's Big Four Potato Grower	Portland
6213	Darling's Blood, Bone and Potash	Portland
6415	Darling's Blood, Bone and Potash	Monticello

Analysis of Fertilizer Samples, 1922.

Station number	Water	NITROGEN				PHOSPHORIC ACID				POTASH	
		As nitrate and ammonia	Active	Total		Available		Total			
				Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6194	5.49	3.30	3.97	4.19	4.11	8.19	8.00	9.03	9.00	7.26	7.00
6257	7.90	3.20	3.81	4.10	4.11	7.88	8.00	9.62	9.00	7.23	7.00
6201	6.14	3.02	3.79	4.03	4.11	7.16	7.00	8.13	8.00	10.34	10.00
6211	6.00	3.38	3.87	4.09	4.11	7.09	7.00	8.21	8.00	10.64	10.00
6188	7.81	3.70	3.90	4.11	4.11	7.94	8.00	9.09	9.00	6.86	7.00
6394	7.20	3.10	3.32	3.52	4.11	7.90	8.00	8.92	9.00	5.75	7.00
6184	7.03	2.92	3.13	3.29	3.29	8.08	8.00	8.95	9.00	7.40	7.00
6276	7.48	2.74	3.09	3.27	3.29	8.09	8.00	8.96	9.00	7.12	7.00
6247	6.51	4.34	4.70	4.84	4.94	6.43	6.00	7.88	7.00	4.02	4.00
6480	9.09	4.26	5.06	5.26	4.94	6.83	6.00	8.26	7.00	4.17	4.00
6190	5.63	2.68	3.06	3.24	3.29	6.54	6.00	7.30	7.00	10.16	10.00
6471	6.01	2.72	3.14	3.33	3.29	6.35	6.00	7.27	7.00	10.13	10.00
6185	9.14	1.32	1.62	1.73	1.65	7.78	8.00	8.80	9.00	2.21	2.00
6468	7.60	1.46	1.65	1.91	1.65	8.15	8.00	9.12	9.00	2.94	2.00
6197	8.11	0.78	0.78	1.02	0.82	8.25	8.00	8.58	9.00	2.33	2.00
6472	8.94	1.02	0.99	1.15	0.82	8.28	8.00	9.12	9.00	2.54	2.00
6182	7.63	2.86	3.17	3.30	3.29	8.33	8.00	9.22	9.00	4.05	4.00
6256	7.77	2.28	2.83	2.98	3.29	8.39	8.00	9.54	9.00	4.48	4.00
6217	7.07	1.34	1.70	1.83	1.65	8.36	8.00	9.19	9.00	3.45	3.00
6187	8.85	1.70	1.58	1.71	1.65	7.99	8.00	8.63	9.00	3.26	3.00
6189	7.18	1.82	2.30	2.48	2.47	8.16	8.00	9.28	9.00	4.54	4.00
6470	8.58	1.96	2.49	2.74	2.47	8.01	8.00	9.44	9.00	4.57	4.00
6183	10.13	1.84	2.39	2.67	2.47	9.00	9.00	10.40	10.00	2.18	2.00
6469	8.00	1.58	2.19	2.70	2.47	8.84	9.00	10.17	10.00	2.75	2.00
6252	7.71	1.42	1.45	1.64	1.65	7.88	8.00	8.77	9.00	2.15	2.00
6233	6.52	1.32	1.53	1.73	1.65	8.36	8.00	9.23	9.00	3.23	3.00
6269	6.96	2.56	3.02	3.22	3.29	5.56	6.00	6.86	7.00	10.23	10.00
6255	6.30	3.42	4.01	4.24	4.11	8.23	8.00	9.12	9.00	7.26	7.00
6156	8.01	1.96	2.35	2.54	2.47	8.08	8.00	9.15	9.00	4.14	4.00
6245	6.48	1.80	2.23	2.48	2.47	8.08	8.00	9.25	9.00	4.55	4.00
6248	7.96	1.30	1.60	1.73	1.65	7.97	8.00	8.71	9.00	2.47	2.00
6266	7.95	0.76	0.88	1.02	0.82	8.14	8.00	9.06	9.00	2.22	2.00
6232	6.65	1.28	1.63	1.74	1.65	8.51	8.00	9.28	9.00	3.55	3.00
6260	7.54	1.92	3.16	3.30	3.29	7.77	8.00	8.87	9.00	4.04	4.00
6213	5.87	2.94	3.88	4.10	4.11	6.96	8.00	7.88	9.00	8.78	7.00
6415	7.99	3.16	3.81	4.11	4.11	8.27	8.00	9.09	9.00	7.15	7.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6453	Darling's Complete 10% Manure	Caribou
6410	Darling's Concentrated Fertilizer	Houlton
6434	Darling's Concentrated Fertilizer	Presque Isle
6536	Darling's Potato & Root Crop Manure	Atkinson
6223	Grass and Lawn Top Dressing	Portland
6157	Grass and Oats Fertilizer	Bangor
6258	Grass and Oats Fertilizer	Portland
6240	Great Eastern General	Portland
6164	Great Eastern High Grade Potato Manure	Bangor
6250	Great Eastern High Grade Potato Manure	Portland
6267	Great Eastern Leader	Portland
6416	Great Eastern Leader	Monticello
6251	Great Eastern Northern Corn Special	Portland
6162	Great Eastern Northern Maine Potato Special	Bangor
6438	Great Eastern Northern Maine Potato Special	Fort Fairfield
6180	Great Eastern Potato Manure	Bangor
6179	Great Eastern Potato Special	Bangor
6220	Great Eastern Potato Special	Portland
6259	Great Eastern Superior Potato Grower	Portland
6161	Great Harvester Potato Manure	Bangor
6215	Great Harvester Potato Manure	Portland
6246	High Grade Acid Phosphate	Portland
6481	High Grade Acid Phosphate	Calais
6193	Lister's Corn and Potato Fertilizer	Bangor
6218	Lister's Corn and Potato Fertilizer	Portland
6263	Lister's Eastern Pride Fertilizer	Portland
6262	Lister's 5-7-10 Fertilizer For Potatoes	Portland
6221	Lister's 4-8-4 Fertilizer	Portland
6225	Lister's Grain and Grass Fertilizer	Portland
6160	Lister's High Grade Potato Fertilizer	Bangor
6228	Lister's High Grade Potato Fertilizer	Portland
6191	Lister's Potato Manure	Bangor
6222	Lister's Potato Manure	Portland
6192	Lister's Success Fertilizer	Bangor
6219	Lister's Success Fertilizer	Portland
6159	Lister's 10% Potato Grower	Bangor
6226	Lister's 10% Potato Grower	Portland

Analysis of Fertilizer Samples, 1922.

Station number	Water	NITROGEN				PHOSPHORIC ACID				POTASH	
		As nitrate and ammonia	Active	Total		Available		Total		Found	Guaranteed
				Found	Guaranteed	Found	Guaranteed	Found	Guaranteed		
6453	5.44	2.98	3.06	3.32	3.29	6.16	6.00	6.95	7.00	10.46	10.00
6410	7.15	3.20	3.72	4.03	4.11	7.04	7.00	7.78	8.00	10.42	10.00
6434	7.27	3.36	3.86	4.13	4.11	7.38	7.00	7.97	8.00	10.45	10.00
6536	8.90	2.68	3.18	3.36	3.29	8.01	8.00	9.03	9.00	7.13	7.00
6223	7.67	4.27	4.75	4.92	4.94	6.70	6.00	7.75	7.00	4.20	4.00
6157	9.74	--------	------	------	------	11.98	12.00	13.71	13.00	2.19	2.00
6258	10.05	--------	------	------	------	11.86	12.00	13.45	13.00	2.24	2.00
6240	6.52	0.66	0.86	0.98	0.82	8.15	8.00	9.09	9.00	2.19	2.00
6164	6.22	2.68	3.12	3.31	3.29	5.98	6.00	6.95	7.00	10.21	10.00
6250	5.21	2.76	3.24	3.38	3.29	6.44	6.00	7.18	7.00	9.51	10.00
6267	7.61	3.36	3.84	4.05	4.11	7.14	7.00	8.19	8.00	10.07	10.00
6416	7.32	2.80	3.66	4.00	4.11	7.68	7.00	8.29	8.00	10.25	10.00
6251	8.22	1.36	1.55	1.67	1.65	8.13	8.00	8.96	9.00	2.36	2.00
6162	7.09	3.32	4.02	4.26	4.11	8.21	8.00	9.03	9.00	7.31	7.00
6438	7.47	3.22	3.87	4.11	4.11	7.88	8.00	8.70	9.00	7.44	7.00
6180	9.23	1.30	1.68	1.85	1.65	8.13	8.00	9.41	9.00	3.22	3.00
6179	7.90	2.44	3.00	3.21	3.29	8.03	8.00	9.38	9.00	6.57	7.00
6220	7.74	2.70	3.27	3.49	3.29	8.08	8.00	9.36	9.00	7.08	7.00
6259	8.58	2.64	3.10	3.24	3.29	8.42	8.00	9.12	9.00	4.52	4.00
6161	6.83	3.36	3.84	4.12	4.11	6.97	7.00	7.86	8.00	10.54	10.00
6215	5.86	3.48	3.99	4.21	4.11	7.62	7.00	8.64	8.00	9.96	10.00
6246	11.62	--------	------	------	------	14.35	16.00	15.37	17.00	--------	--------
6481	6.98	--------	------	------	------	16.13	16.00	17.28	17.00	--------	--------
6193	7.26	1.40	1.73	1.86	1.65	8.40	8.00	9.22	9.00	3.40	3.00
6218	8.12	1.28	1.56	1.70	1.65	8.21	8.00	9.00	9.00	3.24	3.00
6263	6.79	2.60	3.05	3.23	2.47	8.02	8.00	9.12	9.00	5.67	4.00
6262	6.11	3.58	3.84	4.17	4.11	6.78	7.00	8.16	8.00	10.45	10.00
6221	9.01	2.66	3.21	3.38	3.29	8.19	8.00	9.06	9.00	4.45	4.00
6225	13.13	--------	------	------	------	11.74	12.00	13.21	13.00	2.18	2.00
6160	5.09	3.54	3.84	4.20	4.11	8.03	8.00	8.85	9.00	7.24	7.00
6228	7.25	3.38	3.88	4.10	4.11	8.28	8.00	9.50	9.00	6.96	7.00
6191	6.60	2.66	3.17	3.35	3.29	8.00	8.00	9.15	9.00	6.89	7.00
6222	7.64	2.58	3.07	3.31	3.29	8.11	8.00	9.56	9.00	7.45	7.00
6192	7.56	1.30	1.59	1.73	1.65	7.93	8.00	8.87	9.00	2.51	2.00
6219	7.15	1.16	1.67	1.67	1.65	7.80	8.00	8.64	9.00	2.18	2.00
6159	5.61	2.72	3.04	3.23	3.29	5.97	6.00	6.86	7.00	10.47	10.00
6226	5.51	2.74	3.08	3.36	3.29	6.41	6.00	7.05	7.00	10.16	10.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6195	Monarch Potato Manure	Bangor
6241	Monarch Potato Manure	Portland
6506	Muriate of Potash	Portland
6236	Pacific Potato Special	Portland
6285	Packer's Union Animal Corn Fertilizer	Portland
6230	Packer's Union Potato Manure	Portland
6249	Packer's Union Universal Fertilizer	Portland
6196	Peerless Potato Manure	Bangor
6243	Peerless Potato Manure	Portland
6546	Potapsco 5-8-7 Fertilizer	Lisbon Falls
6521	Potapsco Peerless Potato Guano	Lewiston
6237	Quinnipiac Corn Manure	Portland
6496	Quinnipiac Corn Manure	Springvale
6560	Quinnipiac Market Garden Manure	Saco
6214	Quinnipiac Potato Phosphate	Portland
6495	Quinnipiac Potato Phosphate	Springvale
6568	Read's Farmer's Friend Superphosphate	Oakland
6212	Read's Practical Potato Special Fertilizer	Portland
6229	Soluble Pacific Guano	Portland
6291	Special Ground Bone	Portland
6254	Standard Fertilizer	Portland
6270	Standard Special for Potatoes	Portland
6158	Universal Phosphate	Bangor
6244	Universal Phosphate	Portland
6238	Williams & Clark Americus Ammoniated Bone Superphosphate	Portland
6253	Williams & Clark Americus Corn Phosphate	Portland
6224	Williams & Clark Americus High Grade Special for Potatoes and Vegetables	Portland
6231	Williams & Clark Americus Potato Manure	Portland
6239	Williams & Clark Potato Phosphate	Portland
	ARMOUR FERTILIZER WORKS, NEW YORK CITY.	
6209	Armour's Big Crop Acid Phosphate 16%	Bucksport
6374	Armour's Big Crop Acid Phosphate 16%	Yarmouth
6363	Armour's Big Crop Fertilizer Corn Grower	No. Yarmouth

Analysis of Fertilizer Samples, 1922.

		NITROGEN				PHOSPHORIC ACID				POTASH	
				Total		Available		Total			
Station number	Water	As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6195	8.60	2.60	3.08	3.34	3.29	7.78	8.00	8.49	9.00	4.38	4.00
6241	7.95	0.50	3.09	3.26	3.29	8.00	8.00	8.92	9.00	4.53	4.00
6506	0.97	--------	------	------	------	--------	--------	--------	--------	51.64	48.00
6236	9.30	1.46	1.64	1.92	1.65	8.00	8.00	8.84	9.00	3.61	3.00
6285	6.91	2.08	2.29	2.56	2.47	9.23	9.00	10.33	10.00	2.26	2.00
6290	8.28	1.32	1.76	1.88	1.65	8.05	8.00	8.80	9.00	3.78	3.00
6249	8.49	1.16	1.42	1.58	0.82	8.00	8.00	8.76	9.00	2.62	2.00
6196	6.63	2.72	3.20	3.36	3.29	8.18	8.00	9.25	9.00	6.78	7.00
6243	7.04	2.42	3.03	3.27	3.29	8.01	8.00	9.41	9.00	7.20	7.00
6546	10.05	2.76	3.85	4.34	4.11	8.08	8.00	9.28	9.00	7.20	7.00
6521	8.62	2.42	3.00	3.30	3.29	8.33	8.00	9.50	9.00	4.26	4.00
6287	8.14	1.38	1.87	1.96	1.65	8.27	8.00	9.06	9.00	3.05	2.00
6496	5.76	1.38	1.57	1.73	1.65	8.03	8.00	8.54	9.00	2.12	2.00
6560	9.98	1.98	2.80	3.30	3.29	7.81	8.00	9.21	9.00	7.42	7.00
6214	7.96	1.28	1.33	1.65	1.65	8.38	8.00	9.12	9.00	3.09	3.00
6495	5.72	1.22	1.54	1.71	1.65	8.22	8.00	9.21	9.00	3.13	3.00
6568	8.51	1.30	1.58	1.76	1.65	7.90	8.00	9.05	9.00	2.64	2.00
6212	7.48	1.36	1.72	1.85	1.65	8.30	8.00	9.12	9.00	3.78	3.00
6229	8.17	1.32	1.41	1.73	1.65	8.52	8.00	9.18	9.00	3.17	2.00
6291	5.76	--------	------	2.25	2.06	--------	--------	23.00	22.88	--------	--------
6254	7.19	1.20	1.54	1.67	1.65	8.11	8.00	8.90	9.00	2.06	2.00
6270	9.49	1.30	1.61	1.73	1.65	8.34	8.00	9.00	9.00	3.47	3.00
6158	7.65	0.70	0.87	0.97	0.82	8.38	8.00	9.38	9.00	4.15	2.00
6244	7.02	1.32	1.54	1.79	0.82	8.78	8.00	9.63	9.00	2.25	2.00
6238	7.62	1.96	2.57	2.74	2.47	9.24	9.00	10.46	10.00	2.32	2.00
6253	8.24	1.36	1.58	1.74	1.65	8.18	8.00	8.87	9.00	2.38	2.00
6224	7.48	2.72	3.21	3.43	3.29	8.02	8.00	9.50	9.00	7.04	7.00
6231	7.51	1.26	1.64	1.76	1.65	8.32	8.00	9.19	9.00	3.28	3.00
6239	7.65	2.62	3.04	3.20	2.47	8.41	8.00	9.40	9.00	4.28	4.00
6209	8.33	--------	------	------	------	15.93	16.00	16.75	16.50	--------	--------
6374	6.72	--------	------	------	------	16.74	16.00	17.45	17.00	--------	--------
6368	10.97	1.38	1.75	1.80	1.65	11.75	12.00	11.93	12.50	2.92	2.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6207	Armour's Big Crop Fertilizer Corn Grower 2-12-2	Bucksport
6510	Armour's Big Crop Fertilizer 5-8-5	Portland
6204	Armour's Big Crop Fertilizer 5-8-7	Searsport
6372	Armour's Big Crop Fertilizer 5-8-7	Yarmouth
6373	Armour's Big Crop Fertilizer 5-7-10	Yarmouth
6418	Armour's Big Crop Fertilizer 5-7-10	Mars Hill
6497	Armour's Big Crop Fertilizer 4-8-4	Springvale
6208	Armour's Big Crop Fertilizer 4-8-6	Bucksport
6308	Armour's Big Crop Fertilizer 4-8-6	Topsfield
6371	Armour's Big Crop Fertilizer 4-6-10	Yarmouth
6531	Armour's Big Crop Fertilizer 4-6-10	Yarmouth
6392	Armour's Big Crop Fertilizer 2-10-6	Portland
6498	Armour's Big Crop Fertilizer 2-10-6	Springvale
6390	Armour's Ground Tankage	Portland
6388	Armour's Muriate of Potash	Portland
6389	Armour's Nitrate of Soda	Portland
6391	Armour's Sheep Manure	Portland
6313	Armour's 2-8-2 Fertilizer	Newport
6393	Armour's 2-8-2 Fertilizer	Portland
6511	Bone Meal	Portland
6205	Tuscarora Fertilizer 5-8-7	Searsport
6423	Tuscarora Fertilizer 5-8-7	Ft. Fairfield
6202	Tuscarora Brand 5-7-10	Searsport
6451	Tuscarora Brand 5-7-10	Caribou
	AROOSTOOK FEDERATION OF FARMERS, CARIBOU, ME.	
6398	Aroostook Farmer's Friend Potato Fertilizer 5-8-7	Houlton
6436	Aroostook Farmer's Friend Potato Fertilizer 5-8-7	Presque Isle
6435	Aroostook Farmer's Friend Potato Fertilizer 5-8-10	Presque Isle
6397	Aroostook Farmer's Friend Potato Fertilizer 4-8-6	Houlton
6399	Aroostook Farmer's Friend Potato Fertilizer 4-6-8	Houlton
6437	Aroostook Farmer's Friend Potato Fertilizer 4-6-8	Presque Isle
6450	Aroostook Farmer's Friend Potato Fertilizer 4-6-10	Washburn
	ATLANTIC PACKING COMPANY, BOSTON, MASS.	
6499	Atlantic High Grade Acid Phosphate	Gorham
6500	Atlantic Packing Co. 4-8-4 Fertilizer	Gorham

Analysis of Fertilizer Samples, 1922.

Station number	Water	Nitrogen				Phosphoric Acid				Potash	
				Total		Available		Total			
		As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6207	10.76	1.12	1.64	1.81	1.65	11.89	12.00	12.50	12.50	2.47	2.00
6510	4.96	3.30	3.86	4.10	4.11	7.88	8.00	8.42	9.00	5.10	5.00
6204	6.50	3.10	3.82	4.14	4.11	8.15	8.00	8.58	9.00	7.45	7.00
6372	5.84	3.26	3.87	3.93	4.11	8.47	8.00	8.80	9.00	8.12	7.00
6373	7.18	3.22	3.71	3.92	4.11	7.48	7.00	8.07	8.00	10.12	10.00
6418	5.50	2.82	3.52	3.74	4.11	7.33	7.00	8.10	8.00	10.81	10.00
6497	4.52	1.96	2.84	3.29	3.29	7.84	8.00	8.38	9.00	4.11	4.00
6208	7.54	2.62	3.19	3.33	3.29	8.07	8.00	8.55	8.50	6.06	6.00
6308	8.40	2.40	3.12	3.50	3.29	8.01	8.00	8.01	9.00	6.44	6.00
6371	6.06	2.50	2.94	3.18	3.29	6.71	6.00	7.27	7.00	9.97	10.00
6531	4.83	2.52	3.04	3.27	3.29	6.11	6.00	6.95	7.00	10.55	10.00
6392	7.03	1.26	1.39	1.48	1.65	9.35	10.00	10.11	11.00	6.36	6.00
6498	6.43	1.28	1.56	1.72	1.65	9.85	10.00	10.31	11.00	5.93	6.00
6390	5.10	--------	------	4.80	5.76	--------	--------	10.29	15.00	--------	--------
6388	0.50	--------	------	------	------	--------	--------	--------	--------	49.08	48.00
6389	0.45	14.73	14.73	14.73	14.81						
6391	21.07	--------	------	1.25	1.23	--------	--------	1.47	1.00	3.04	2.50
6313	4.45	1.30	1.48	1.70	1.65	8.16	8.00	8.29	9.00	2.07	2.00
6393	5.70	1.48	1.55	1.70	1.65	8.17	8.00	8.71	9.00	2.43	2.00
6511	4.23	--------	------	2.91	2.47	--------	--------	23.97	22.00	--------	--------
6205	6.28	3.12	3.84	4.15	4.11	8.39	8.00	8.80	9.00	7.38	7.00
6423	9.29	2.84	3.90	4.13	4.11	8.00	8.00	8.13	9.00	6.75	7.00
6202	6.65	2.84	3.49	3.90	4.11	7.48	7.00	7.53	8.00	9.69	10.00
6451	4.93	3.26	3.87	4.12	4.11	6.92	7.00	7.81	8.00	10.07	10.00
6398	6.85	3.10	2.90	4.21	4.11	10.06	8.00	10.88	9.00	7.76	7.00
6436	6.16	3.06	3.92	4.18	4.11	8.83	8.00	9.95	9.00	6.98	7.00
6435	6.21	3.04	3.78	4.12	4.11	8.11	8.00	9.69	9.00	10.40	10.00
6397	6.56	2.28	2.95	3.26	3.29	8.01	8.00	8.70	9.00	7.15	6.00
6399	4.46	2.62	3.01	3.28	3.29	5.52	6.00	6.38	7.00	9.15	8.00
6437	4.27	2.64	2.92	3.28	3.29	4.83	6.00	7.81	7.00	9.63	8.00
6450	6.34	2.56	2.96	3.29	3.29	6.96	6.00	8.74	7.00	10.41	10.00
6499	9.05	--------	------	------	------	17.49	16.00	17.95	17.00	--------	--------
6500	6.86	1.86	3.13	3.66	3.28	8.28	8.00	9.45	9.00	4.31	4.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
	BEACH SOAP COMPANY, LAWRENCE, MASS.	
6486	**Beach's Fertilizer Bone**	**Berwick**
	BOWKER FERTILIZER COMPANY, BOSTON, MASS.	
6176	**Bowker's All Round Fertilizer**	**Bangor**
6170	**Bowker's Corn, Grain and Grass Phosphate**	**Bangor**
6177	**Bowker's Early Potato Manure**	**Bangor**
6292	**Bowker's Hill and Drill Phosphate**	**Portland**
6166	**Bowker's Potato and Vegetable Phosphate**	**Bangor**
6288	**Bowker's 16% Acid Phosphate**	**Portland**
6289	**Bowker's Square Brand Farm and Garden Phosphate**	**Portland**
6168	**Bowker's Sure Crop Phosphate**	**Bangor**
6411	**Stockbridge "A" for Potatoes**	**Houlton**
6426	**Stockbridge "A" for Potatoes**	**Fort Fairfield**
6419	**Stockbridge Early Crop Manure**	**Blaine**
6427	**Stockbridge Early Crop Manure**	**Fort Fairfield**
6181	**Stockbridge Market Garden Manure**	**Bangor**
6277	**Stockbridge Potato and Vegetable Manure**	**Lincoln**
6425	**Stockbridge Potato and Vegetable Manure**	**Fort Fairfield**
	BUFFALO FERTILIZER WORKS, HOULTON, MAINE.	
6408	**Buffalo 5-8-7 Fertilizer**	**Hodgdon**
6409	**Buffalo 5-7-10 Fertilizer**	**Houlton**
6422	**Buffalo 5-7-10 Fertilizer**	**Fort Fairfield**
6452	**Buffalo 5-7-10 Fertilizer**	**Caribou**
6460	**Buffalo 4-8-4 Fertilizer**	**Westfield**
6477	**Buffalo 4-8-7 Fertilizer**	**East Newport**
6407	**Buffalo 4-6-10 Fertilizer**	**Hodgdon**
6461	**Buffalo 4-6-10 Fertilizer**	**Westfield**
6585	**Buffalo 4½-7-10**	**Corinna**
6537	**Buffalo 1-8-4 Fertilizer**	**Hartland**
6545	**Buffalo 16%**	**Lisbon Falls**
6559	**Buffalo 3-8-6 Fertilizer**	**Durham**
6564	**Buffalo 3-8-6 Fertilizer**	**Bethel**
6475	**Buffalo 3-9-1 Fertilizer**	**East Newport**
6523	**Buffalo 3-9-1 Fertilizer**	**Hampden**
6563	**Buffalo Two-Eight-Two Fertilizer**	**Bethel**
6566	**Buffalo Two-Ten-Four Fertilizer**	**East Vassalboro**

Analysis of Fertilizer Samples, 1922.

		NITROGEN				PHOSPHORIC ACID				POTASH	
				Total		Available		Total			
Station number	Water	As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6486	4.90	-------	-----	3.56	2.67	-------	-------	22.44	25.00	-------	-------
6176	10.04	1.98	2.48	2.78	2.47	7.85	8.00	9.28	9.00	4.52	4.00
6170	9.58	1.28	1.75	1.92	1.65	8.12	8.00	9.19	9.00	2.65	2.00
6177	7.15	2.54	3.09	3.30	3.29	7.79	8.00	9.01	9.00	7.06	7.00
6292	7.74	2.04	2.50	2.72	2.47	9.19	9.00	10.40	10.00	2.43	2.00
6166	9.09	1.28	1.63	1.83	1.65	8.03	8.00	9.05	9.00	3.15	3.00
6288	8.07	-------	-----	-----	-----	16.14	16.00	17.70	17.00	-------	-------
6289	7.09	1.28	1.65	1.77	1.65	8.14	8.00	9.03	9.00	2.45	2.00
6168	7.54	0.58	-----	1.00	0.82	8.17	8.00	9.22	9.00	2.20	2.00
6411	6.53	3.10	3.77	3.93	4.11	7.01	7.00	7.72	8.00	10.18	10.00
6426	7.24	3.24	3.77	4.00	4.11	7.03	7.00	7.97	8.00	10.32	10.00
6419	7.79	3.38	3.85	4.13	4.11	8.20	8.00	8.84	9.00	7.51	7.00
6427	7.49	3.30	3.87	4.11	4.11	8.16	8.00	9.00	9.00	7.56	7.00
6181	10.24	2.34	2.76	3.19	3.29	7.39	8.00	8.84	9.00	4.21	4.00
6277	6.03	3.08	3.09	3.30	3.29	6.26	6.00	7.05	7.00	9.96	10.00
6425	5.92	2.84	3.09	3.29	3.29	6.55	6.00	7.24	7.00	10.30	10.00
6408	6.08	2.76	3.60	4.12	4.12	8.25	8.00	8.84	9.00	7.63	7.00
6409	8.15	2.60	3.50	4.11	4.12	7.34	7.00	7.62	8.00	10.17	10.00
6422	8.78	2.62	3.41	4.02	4.12	7.35	7.00	7.66	8.00	10.01	10.00
6452	6.33	2.82	3.86	4.11	4.12	7.12	7.00	7.71	8.00	10.66	10.00
6460	5.49	2.02	2.89	3.28	3.29	8.53	8.00	9.09	9.00	4.19	4.00
6477	4.90	2.14	3.23	3.53	3.29	8.51	8.00	9.15	9.00	7.58	7.00
6407	7.16	2.26	3.25	3.42	3.29	6.34	6.00	6.95	7.00	10.63	10.00
6461	7.85	2.18	2.91	3.28	3.29	6.34	6.00	6.44	7.00	10.38	10.00
6585	10.20	2.40	3.41	3.86	3.70	7.21	7.00	7.62	8.00	9.72	10.00
6537	5.94	1.02	0.88	1.07	0.80	8.73	8.00	8.86	9.00	4.40	4.00
6545	7.86	-------	-----	-----	-----	16.15	16.00	18.14	17.00	-------	-------
6559	6.73	1.40	2.22	2.68	2.50	8.58	8.00	9.47	9.00	7.56	6.00
6564	5.90	1.72	2.37	2.66	2.50	8.69	8.00	9.58	9.00	6.63	6.00
6475	5.46	1.50	3.10	3.35	2.50	9.16	9.00	11.48	10.00	3.66	1.00
6523	5.85	1.60	2.07	2.59	2.50	9.00	9.00	9.79	10.00	1.95	1.00
6563	6.37	0.92	1.45	1.69	1.65	8.36	8.00	11.22	9.00	2.29	2.00
6566	9.19	1.12	1.61	1.86	1.65	10.89	10.00	12.21	11.00	4.50	4.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
	JOSEPH BRECK & SONS CORP., BOSTON, MASS.	
6375	Breck's Rams Head Brand Pulverized Sheep Manure	Sanford
	CHICAGO FEED & FERTILIZER CO., CHICAGO, ILL.	
6508	Magic Brand Pulverized Sheep Manure	Portland
	E. D. CHITTENDEN CO., BRIDGEPORT, CONN.	
6420	Chittenden's High Grade Potato with 7% Potash	Mars Hill
	THE COE-MORTIMER CO INC., BOSTON, MASS.	
6167	E. Frank Coe's Celebrated Special Potato Fertilizer	Bangor
6234	E. Frank Coe's Celebrated Special Potato Fertilizer	Portland
6169	E. Frank Coe's Columbian Corn and Potato Fertilizer	Bangor
6271	E. Frank Coe's Columbian Corn and Potato Fertilizer	Portland
6402	E. Frank Coe's Double Strength Potato Manure	Houlton
6433	E. Frank Coe's Double Strength Potato Manure	Presque Isle
6299	E. Frank Coe's Gold Brand Excelsior Guano	Freeport
6298	E. Frank Coe's New Englander Special	Freeport
6178	E. Frank Coe's Potato and Truck Manure	Bangor
6431	E. Frank Coe's Potato and Truck Manure	Presque Isle
6172	E. Frank Coe's Red Brand Excelsior Guano	Bangor
6261	E. Frank Coe's Red Brand Excelsior Guano	Portland
6358	E. Frank Coe's 16% Superphosphate	Kennebunk
6173	E. Frank Coe's Standard Potato Fertilizer	Bangor
6235	E. Frank Coe's Standard Potato Fertilizer	Portland
	CONSOLIDATED RENDERING CO., BOSTON, MASS.	
6351	Acid Phosphate High Grade	Gorham
6352	Muriate of Potash	Gorham
6350	Sulphate of Ammonia	Gorham
	THE CORINNA SEED POTATO FARMS, CORINNA, MAINE.	
6473	Corinna Farms Special Potato Grower	No. Dixmont
6584	Corinna Farms Special Potato Grower	Corinna
6586	Corinna Farms Special Potato Grower	Exeter
	DAVIS MARINE DEPOSITS AND REFINING CO., SCARBORO, MAINE.	
6512	Davis Marine Ash	Portland
6573	Davis Marine Ash	Bath
6513	Liquid Plant Food	Portland
	DOMINION FERTILIZER CO. LTD., ST. STEPHENS, N. B.	
6458	Dominion 5-8-7 Fertilizer	Caribou
6463	Dominion 5-8-7 Fertilizer	Westfield
6428	Dominion 5-7-10 Fertilizer	Presque Isle
6457	Dominion 5-7-10 Fertilizer	Caribou

Analysis of Fertilizer Samples, 1922.

Station number	Water	NITROGEN				PHOSPHORIC ACID				POTASH	
		As nitrate and ammonia	Active	Total		Available		Total			
				Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6375	16.95	------	------	1.52	1.46	------	------	0.99	0.75	3.57	3.00
6508	9.34	------	------	2.03	1.85	------	1.43	1.29	1.50	4.00	1.25
6420	6.93	3.48	3.94	4.13	4.12	9.25	8.00	9.79	9.00	7.00	7.00
6167	10.89	2.14	2.76	3.11	3.29	7.69	8.00	9.04	9.00	4.45	4.00
6234	7.74	2.72	3.12	3.29	3.29	8.11	8.00	8.93	9.00	4.45	4.00
6169	9.43	1.26	1.64	1.83	1.65	8.05	8.00	9.15	9.00	2.96	3.00
6271	8.55	1.12	1.58	1.72	1.65	8.10	8.00	9.38	9.00	3.30	3.00
6402	5.54	3.54	3.76	4.09	4.11	7.41	7.00	8.23	8.00	10.56	10.00
6433	6.74	3.22	3.90	4.18	4.11	6.98	7.00	7.87	8.00	10.47	10.00
6299	8.38	1.82	2.21	2.46	2.47	8.37	8.00	9.19	9.00	4.59	4.00
6298	5.82	0.76	0.85	1.00	0.82	8.88	8.00	10.05	9.00	2.30	2.00
6178	7.14	3.24	3.79	4.07	4.11	8.03	8.00	8.87	9.00	7.57	7.00
6431	7.13	3.54	4.01	4.27	4.11	8.20	8.00	8.86	9.00	7.52	7.00
6172	6.82	2.70	3.27	3.40	3.29	7.81	8.00	9.03	9.00	7.10	7.00
6261	8.12	2.76	3.16	3.35	3.29	8.01	8.00	9.18	9.00	6.94	7.00
6358	9.32	------	------	------	------	16.62	16.00	17.64	17.00	------	------
6173	6.45	2.66	3.08	3.24	3.29	5.99	6.00	7.11	7.00	9.96	10.00
6235	5.63	2.66	3.25	3.49	3.29	6.47	6.00	7.11	7.00	10.27	10.00
6351	9.42	------	------	------	------	16.97	16.00	17.23	16.50	------	------
6352	0.35	------	------	------	------	------	------	------	------	50.80	50.00
6350	1.70	19.92	19.92	19.92	20.50						
6473	6.96	2.46	3.96	4.46	4.12	8.31	8.00	9.28	9.00	7.87	7.00
6584	9.27	2.40	4.03	4.42	5.00	9.12	8.00	10.42	------	8.00	7.00
6586	9.23	2.80	4.01	4.56	5.00	9.50	8.00	10.78	------	7.00	7.00
6512	4.08	------	------	0.45	0.41	------	0.17	0.64	0.32	1.34	0.91
6573	7.63	------	------	0.41	0.14	------	0.17	0.80	0.32	3.47	0.91
6513	------	------	------	0.42	0.14	------	------	------	------	0.10	0.17
6458	9.12	2.62	3.84	4.31	4.10	8.15	8.00	8.58	9.00	7.57	7.00
6463	9.14	2.74	3.80	4.15	4.10	8.03	8.00	8.29	9.00	7.50	7.00
6428	7.89	2.28	3.64	4.19	4.10	6.82	7.00	7.36	8.00	10.07	10.00
6457	8.12	2.74	3.75	4.25	4.10	7.30	7.00	7.81	8.00	8.40	10.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6429	Dominion 4½-7-10 Fertilizer	Presque Isle
6448	Dominion 4½-7-10 Fertilizer	Washburn
6447	Dominion 4-6-10 Fertilizer	Washburn
6459	Dominion 4-6-10 Fertilizer	Caribou
	WILLIS R. DRESSER, CALAIS, MAINE.	
6467	Big D. Fertilizer 5-7-10	Calais
6465	Big D. Fertilizer 4-6-10	Calais
6466	Big D. Fertilizer 3-8-4	Calais
6464	Big D. Fertilizer 2-8-2	Calais
	EASTERN STATES FARMERS' EXCHANGE, SPRINGFIELD, MASS.	
6359	Eastern States 4-8-4 Fertilizer	Kennebunk
6379	Eastern States 4-8-4 Fertilizer AAA	Sanford
6362	Eastern States 4-8-7 Fertilizer	Kennebunk
6556	Eastern States 4-6-10 Fertilizer	Cumberland Ct.
6533	Eastern States Muriate of Potash	Pownal
6535	Eastern States Nitrate of Soda	Pownal
6361	Eastern States 16% Acid Phosphate	Kennebunk
6532	Eastern States Sulphate of Ammonia	Pownal
6534	Eastern States Tankage	Pownal
6360	Eastern States 2-8-2 Fertilizer	Kennebunk
6557	Eastern States 2-8-2 Fertilizer BBB	Cumberland Ct.
6377	Nitrate of Soda	Sanford
6376	Nitrate of Soda Reground	Sanford
	ESSEX FERTILIZER CO., BOSTON, MASS.	
6317	Essex Fish Fertilizer 3-8-3 for All Crops	Brunswick
6137	Essex 5-8-7 for Potatoes and Vegetables	Bangor
6414	Essex 5-8-7 for Potatoes and Vegetables	Houlton
6432	Essex 4½-7-10 for Potatoes and Vegetables	Presque Isle
6494	Essex 4-8-4 for Potatoes, Roots and Vegetables	Springvale
6315	Essex 4-8-6 for Potatoes and Vegetables	Brunswick
6318	Essex 4-6-10 for Potatoes and Vegetables	Brunswick
6395	Essex 4-6-10 for Potatoes and Vegetables	Bridgton
6135	Essex Market Garden 3-8-4 for Vegetables and Grass	Bangor
6575	Essex 1-10-1 for Grain and Grass	Nobleboro
6581	Essex Special Mixture 7-7½-5	Presque Isle

Analysis of Fertilizer Samples, 1922.

Station number	Water	Nitrogen				Phosphoric Acid				Potash	
		As nitrate and ammonia	Active	Total		Available		Total			
				Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6429	7.96	2.28	3.40	3.94	3.70	7.45	7.00	7.78	8.00	9.72	10.00
6448	7.29	2.16	3.19	3.65	3.70	7.11	7.00	7.59	8.00	10.31	10.00
6447	7.28	2.34	2.96	3.38	3.29	6.38	6.00	6.76	7.00	9.52	10.00
6459	7.00	2.64	3.10	3.31	3.29	6.66	6.00	7.20	7.00	9.54	10.00
6467	5.98	2.92	3.47	3.66	4.10	7.26	7.00	7.87	8.00	10.34	10.00
6465	6.40	2.44	2.88	3.26	3.29	6.54	6.00	7.20	7.00	10.07	10.00
6466	3.89	2.10	2.50	2.67	2.47	8.34	8.00	9.03	9.00	4.57	4.00
6464	5.88	1.32	1.48	1.66	1.64	7.70	8.00	8.16	9.00	2.10	2.00
6359	8.12	2.42	3.04	3.29	3.29	8.61	8.00	10.24	9.00	4.09	4.00
6379	9.15	2.54	2.97	3.35	3.29	8.77	8.00	9.15	9.00	4.29	4.00
6362	8.23	2.42	3.08	3.26	3.29	8.24	8.00	9.44	9.00	7.16	7.00
6556	8.33	2.12	3.02	3.26	3.29	6.08	6.00	7.43	7.00	9.68	10.00
6533	0.39	--------	------	------	------	--------	--------	--------	--------	51.84	50.00
6535	3.32	15.08	15.08	15.08	14.80						
6361	9.49	--------	------	------	------	15.72	16.00	17.48	17.00	--------	--------
6532	0.56	21.40	21.40	21.40	20.55						
6534	5.29	--------	------	7.12	8.22	5.50	4.57	13.23	--------	--------	--------
6360	8.62	1.16	1.55	1.68	1.65	7.84	8.00	9.09	9.00	2.35	2.00
6557	10.63	0.98	1.45	1.65	1.65	7.92	8.00	9.09	9.00	2.02	2.00
6377	0.53	14.74	14.74	14.74	14.80						
6376	0.54	14.75	14.75	14.75	14.80						
6317	8.04	1.36	2.29	2.46	2.46	7.96	8.00	9.06	9.00	3.31	3.00
6137	8.63	1.92	3.39	4.14	4.10	8.19	8.00	9.31	9.00	7.10	7.00
6414	7.65	2.36	3.67	4.11	4.10	8.39	8.00	8.80	9.00	7.71	7.00
6432	7.58	1.92	3.08	3.42	3.69	7.35	7.00	8.45	8.00	10.05	10.00
6494	6.69	1.46	3.01	3.32	3.28	8.39	8.00	9.44	9.00	4.81	4.00
6315	7.97	1.66	2.93	3.15	3.28	8.37	8.00	9.70	9.00	5.94	6.00
6318	6.45	2.48	3.00	3.30	3.25	6.62	6.00	7.46	7.00	11.47	10.00
6395	6.87	1.80	2.67	3.09	3.28	6.53	6.00	7.37	7.00	9.94	10.00
6135	8.78	1.54	2.49	2.70	2.47	9.00	8.00	9.94	9.00	3.97	4.00
6575	8.10	0.54	0.95	1.13	0.82	9.44	10.00	9.98	11.00	1.58	1.00
6581	8.98	1.98	5.30	5.74	5.74	7.96	7.50	8.67	8.50	5.35	5.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6316	Essex 3-8-4 Market Garden for Vegetables and Grass	Brunswick
6151	Essex 3-6-10 for Corn, Potatoes and Vegetables	Bangor
6319	Essex 3-6-10 for Corn, Potatoes and Vegetables	Brunswick
6574	Essex 3-6-10 for Corn, Potatoes and Vegetables	Damariscotta
6527	Essex 2-8-3 for all crops	Waterville
6493	Essex 2-8-2 for Farm and Garden	Springvale
	LOWELL FERTILIZER COMPANY, BOSTON, MASS.	
6132	Lowell Animal Brand 3-8-4 for All Crops	Corinna
6347	Lowell Animal Brand 3-8-4 for All Crops	Gorham
6552	Lowell Animal Brand 3-8-4 for All Crops	Carmel
6144	Lowell Bone Fertilizer 2-8-2 for Corn, Grain, Grass and Vegetables	Bangor
6355	Lowell Bone Fertilizer 2-8-2 for Corn, Grain, Grass and Vegetables	Gorham
6357	Lowell Empress Brand 1-10-1 for Vegetables and Grain	Gorham
6348	Lowell 5-8-4 for Vegetables and Grass	Gorham
6139	Lowell 5-8-7 for Potatoes and Vegetables	Bangor
6356	Lowell 5-8-7 for Potatoes and Vegetables	Gorham
6353	Lowell 4-8-4 for Potatoes, Corn and Vegetables	Gorham
6443	Lowell 4-8-7 Fertilizer for Potatoes and Vegetables	Belfast
6526	Lowell 4-8-7 Fertilizer for Potatoes and Vegetables	Waterville
6148	Lowell 4-8-6 for Potatoes and Vegetables	Bangor
6131	Lowell 4-6-10	Corinna
6354	Lowell 4-6-10 for Potatoes and Vegetables	Gorham
6561	Lowell 3-8-3 for Corn, Grain and Vegetables	Yarmouth
6150	Lowell 3-6-10 for Corn, Potatoes and Vegetables	Bangor
6146	Lowell 2-8-6 for Grain, Grass and Potatoes	Bangor
6147	Lowell 2-8-3 for Vegetables and Grain	Bangor
	MANCHESTER RENDERING CO., MANCHESTER, N. H.	
6482	Manchester Potato Fertilizer	Berwick
6483	Manchester Special Fertilizer for all Crops	Berwick
	MORISON BROTHERS, BANGOR, MAINE.	
6152	Morison Bros. 5-8-7 Fertilizer	Bangor
6333	Morison Bros. 5-8-7 Fertilizer	East Corinth
6153	Morison Bros. 4-8-4 Fertilizer	Bangor
6331	Morison Bros. 4-8-4 Fertilizer	East Corinth
6155	Morison Bros. 4-8-7 Fertilizer	Bangor
6330	Morison Bros. 4-8-7 Fertilizer	East Corinth

Analysis of Fertilizer Samples, 1922.

Station number	Water	**NITROGEN**				**PHOSPHORIC ACID**				**POTASH**	
		As nitrate and ammonia	Active	**Total**		**Available**		**Total**			
				Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6316	8.63	1.54	2.26	2.45	2.46	8.49	8.00	9.28	9.00	3.95	4.00
6151	5.07	0.84	2.07	2.37	2.46	6.08	6.00	6.51	7.00	10.08	10.00
6319	4.62	0.96	2.32	2.66	2.46	6.43	6.00	6.79	7.00	10.77	10.00
6574	5.50	1.80	2.15	2.44	2.46	5.37	6.00	5.83	7.00	11.51	10.00
6527	7.44	0.90	1.54	1.86	1.64	8.98	8.00	9.59	9.00	3.04	3.00
6493	5.55	0.86	1.44	1.71	1.64	8.31	8.00	8.77	9.00	2.06	2.00
6132	7.82	1.47	2.32	2.46	2.46	8.34	8.00	9.28	9.00	3.98	4.00
6347	10.02	1.74	2.41	2.67	2.46	8.54	8.00	9.89	9.00	4.53	4.00
6552	10.79	1.56	2.38	2.48	2.46	8.01	8.00	9.18	9.00	4.17	4.00
6144	6.82	0.73	1.54	1.69	1.64	8.22	8.00	8.88	9.00	2.08	2.00
6355	7.29	0.84	1.68	1.88	1.64	8.77	8.00	9.41	9.00	2.65	2.00
6357	8.37	0.60	1.31	1.39	0.82	9.04	10.00	10.11	11.00	1.93	1.00
6348	7.20	1.80	3.25	3.81	4.10	7.60	8.00	9.59	9.00	4.76	4.00
6139	8.17	0.57	3.60	4.10	4.10	8.18	8.00	9.35	9.00	7.02	7.00
6356	8.10	2.52	3.96	4.26	4.10	8.07	8.00	9.22	9.00	7.12	7.00
6353	7.97	1.62	3.03	3.29	3.28	8.16	8.00	9.38	9.00	4.28	4.00
6443	8.84	1.80	2.84	3.15	3.28	7.99	8.00	8.93	9.00	7.13	7.00
6526	8.91	1.86	3.01	3.34	3.28	8.18	8.00	9.15	9.00	6.84	7.00
6148	8.55	1.61	1.74	3.21	3.28	8.20	8.00	9.60	9.00	6.25	6.00
6131	6.42	1.58	2.85	3.34	3.28	6.57	6.00	7.46	7.00	10.62	10.00
6354	7.13	1.98	2.88	3.11	3.28	6.90	6.00	7.46	7.00	10.38	10.00
6561	8.60	1.56	2.20	2.44	2.46	8.81	8.00	9.50	9.00	3.27	3.00
6150	5.19	0.82	2.21	2.53	2.46	5.74	6.00	6.17	7.00	9.34	10.00
6146	5.95	0.21	1.63	1.90	1.64	8.04	8.00	8.49	9.00	6.38	6.00
6147	6.69	0.73	1.58	1.71	1.64	8.22	8.00	8.93	9.00	2.11	3.00
6482	5.66	0.38	2.08	2.45	2.40	10.29	6.00	17.89	10.00	3.69	10.00
6483	5.89	1.06	2.07	2.59	2.40	9.24	10.00	14.06	14.00	11.14	3.00
6152	8.75	2.87	3.61	4.24	4.11	8.90	8.00	9.51	9.00	7.15	7.00
6333	8.62	3.36	3.87	4.01	4.11	8.39	8.00	8.49	9.00	7.54	7.00
6153	8.87	1.72	2.70	3.24	3.28	8.20	8.00	9.17	9.00	4.91	4.00
6331	10.09	2.14	2.87	3.27	3.28	8.77	8.00	9.79	9.00	4.29	4.00
6155	8.26	2.54	3.07	3.55	3.29	8.37	8.00	9.03	9.00	7.91	7.00
6339	9.18	2.44	2.89	3.24	3.29	8.62	8.00	9.41	9.00	7.02	7.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6154	Morison Bros. 4-8-10 Fertilizer	Bangor
6332	Morison Bros. 4-8-10 Fertilizer	East Corinth
6329	Morison Bros. 3-10-3 Fertilizer	East Corinth
6334	Nitrate of Soda	East Corinth
	NATIONAL FERTILIZER CO., NEW YORK CITY.	
6547	National Ammoniated Bone Phosphate	Dexter
6230	National Aroostook Special Fertilizer	Searsport
6403	National Aroostook Special Fertilizer	Houlton
6284	National Excelsior Potato Fertilizer	Portland
6449	National Excelsior Potato Fertilizer	Washburn
6274	National Extra High Garde Manure	Lincoln
6404	National Extra High Grade Manure	Houlton
6549	National Market Garden Fertilizer	Dexter
6405	National Pine Tree State Potato Fertilizer	Houlton
6548	National Potato Phosphate	Dexter
6406	National Premier Potato Manure	Houlton
	NATURAL GUANO CO., AURORA, ILL.	
6539	Sheep's Head Pulverized Sheep Manure	Portland
	NEW ENGLAND FERTILIZER CO., BOSTON, MASS.	
6558	New England 5-8-4 for Vegetables and Grass	Westbrook
6141	New England 5-8-7 for Potatoes and Vegetables	Bangor
6421	New England 5-8-7 for Potatoes and Market Garden	Fort Fairfield
6387	New England 4-8-4 for Potatoes, Vegetables and Grass	Gorham
6492	New England 4-8-4 for Potatoes, Vegetables and Grass	So. Berwick
6551	New England 4-8-7 for Potatoes and Vegetables	Etna
6490	New England 4-8-6 for Potatoes and Vegetables	So. Berwick
6446	New England 4½-7-10 for Potatoes and Vegetables	Washburn
6583	New England 4½-7-10	Patten
6142	New England 4-6-10 for Potatoes and Vegetables	Bangor
6349	New England 4-6-10 for Potatoes and Vegetables	Gorham
6488	New England Standard Phosphate 1-10-1 for Grain and Grass	So. Berwick
6143	New England Superphosphate 3-8-4 for all Crops	Bangor
6491	New England Superphosphate 3-8-4 for all Crops	So. Berwick
6550	New England 3-8-3 for Corn, Grain and Vegetables	Etna
6570	New England 3-8-3 for Corn, Grain and Vegetables	Guilford
6149	New England 3-6-10 for Corn, Potatoes and Vegetables	Bangor
6487	New England 3-6-10 for Corn, Potatoes and Vegetables	So. Berwick

Analysis of Fertilizer Samples, 1922.

		NITROGEN				PHOSPHORIC ACID				POTASH	
				Total		Available		Total			
Station number	Water	As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6154	8.48	2.24	2.71	3.19	3.29	8.59	8.00	9.22	9.00	10.58	10.00
6332	8.67	2.46	3.02	3.33	3.29	8.62	8.00	9.51	9.00	10.27	10.00
6329	10.42	1.50	2.21	2.64	2.47	10.67	10.00	11.87	11.00	3.41	3.00
6334	0.75	15.42	15.42	15.42	15.00						
6547	9.60	1.56	1.56	1.74	1.65	8.28	8.00	9.15	9.00	2.32	2.00
6200	6.77	3.38	4.03	4.20	4.11	8.27	8.00	9.09	9.00	7.60	7.00
6403	6.66	3.50	3.82	4.16	4.11	7.92	8.00	8.71	9.00	7.62	7.00
6284	7.13	2.78	3.04	3.27	3.29	6.05	6.00	7.27	7.00	10.34	10.00
6449	7.70	2.62	3.03	3.27	3.29	6.24	6.00	7.17	7.00	9.81	10.00
6274	6.25	3.48	3.89	4.12	4.11	7.31	7.00	8.10	8.00	10.40	10.00
6404	6.89	3.14	3.64	3.90	4.11	6.90	7.00	7.51	8.00	10.66	10.00
6549	9.77	2.38	2.89	3.04	2.47	7.53	8.00	8.42	9.00	6.67	4.00
6405	8.08	2.88	3.02	3.28	3.29	8.19	8.00	8.90	9.00	4.56	4.00
6548	10.14	1.68	1.95	2.08	1.65	8.16	8.00	9.03	9.00	4.21	3.00
6406	8.38	2.98	3.52	3.92	3.29	8.12	8.00	9.24	9.00	7.27	7.00
6509	9.22	--------	------	2.48	2.25	--------	1.00	1.34	1.25	2.22	1.50
6558	7.35	2.02	3.69	4.12	4.10	7.26	8.00	8.74	9.00	4.47	4.00
6141	8.64	2.14	3.60	4.11	4.10	7.95	8.00	9.25	9.00	6.64	7.00
6421	8.00	2.62	3.72	4.18	4.10	8.04	8.00	8.45	9.00	7.19	7.00
6387	7.39	1.78	3.07	3.37	3.28	8.95	8.00	10.02	9.00	4.21	4.00
6492	8.47	2.08	3.31	3.68	3.28	8.16	8.00	9.28	9.00	4.76	4.00
6551	11.05	1.96	3.01	3.32	3.28	8.09	8.00	9.31	9.00	6.79	7.00
6490	6.43	1.94	2.96	3.32	3.28	8.17	8.00	9.47	9.00	6.05	6.00
6446	8.36	2.14	2.97	3.52	3.69	7.41	7.00	8.38	8.00	10.22	10.00
6583	7.89	2.54	3.41	3.71	3.69	7.15	7.00	7.46	8.00	10.24	10.00
6142	7.08	1.54	2.82	3.34	3.28	6.75	6.00	7.37	7.00	10.03	10.00
6349	6.83	1.98	3.04	3.22	3.28	6.46	6.00	7.30	7.00	10.00	10.00
6488	6.56	0.28	0.85	1.08	0.82	10.12	10.00	11.09	11.00	1.18	1.00
6143	7.49	1.50	2.18	2.53	2.46	7.95	8.00	9.00	9.00	4.02	4.00
6491	8.46	1.46	2.27	2.48	2.46	8.62	8.00	9.79	9.00	3.74	4.00
6550	9.72	1.48	2.29	2.50	2.46	7.45	8.00	8.19	9.00	3.12	3.00
6570	7.55	1.50	2.43	2.62	2.46	8.44	8.00	9.28	9.00	3.16	3.00
6149	5.17	0.34	2.00	2.43	2.46	5.63	6.00	6.22	7.00	10.52	10.00
6487	4.54	1.14	2.09	2.46	2.46	5.71	6.00	6.17	7.00	11.00	10.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6505	New England 2-8-3 for Vegetables and Grain	Buxton
6489	New England 2-8-2 Corn Phosphate for Vegetables and Grain	So. Berwick
	N. J. FERTILIZER & CHEMICAL CO., NEW YORK CITY.	
6439	Croxton Brand Special Mixture 4-6-10	Dover-Foxcroft
	OLDS & WHIPPLE, INC., HARTFORD, CONN.	
6430	Olds & Whipple High Grade Potato Fertilizer	Presque Isle
	PARMENTER & POLSEY FERTILIZER CO., BOSTON, MASS.	
6579	Parmenter & Polsey 5-8-7 for Potatoes & Market Gardens	Houlton
6565	Parmenter & Polsey 4-8-4 for Potatoes, Corn & Vegetables	So. Paris
6577	Parmenter & Polsey 4-8-4 for Potatoes, Corn & Vegetables	Belgrade
6578	Parmenter & Polsey 4-8-7 for Potatoes & Vegetables	Vassalboro
6580	Parmenter & Polsey 4-8-7 for Potatoes & Vegetables	Ludlow
6576	Parmenter & Polsey 4-6-10 for Potatoes & Vegetables	Belgrade
6138	P & P Plymouth Rock Brand for All Crops 3-8-4	Bangor
6136	P & P 3-6-10 for Corn, Potatoes and Vegetables	Bangor
6562	Parmenter & Polsey 2-8-3 for Corn, Fruit and Vegetables	Bethel
	PORTLAND RENDERING CO., PORTLAND, MAINE.	
6283	Portland Organic Fertilizer 5-8-7	Portland
6282	Portland Organic Fertilizer 4-8-7	Portland
6280	Portland Organic Fertilizer 4-6-10	Portland
6306	Portland Organic Fertilizer 4-6-10	Danforth
6281	Portland Organic Fertilizer 3-8-4	Portland
6279	Portland Organic Fertilizer 2-8-3	Portland
	PROTO FEED & GUANO CO., CHICAGO, ILL.	
6507	Master Brand Pulverized Sheep Manure	Portland
6514	Master Brand Pulverized Sheep Manure	Lewiston
	ROGERS AND HUBBARD CO., PORTLAND, CONN.	
6302	Complete Phosphate	Freeport
6301	Hubbard's Bone Base Corn and General Crop Manure	Freeport
6540	Hubbard's Bone Base Fertilizer for Oats & Top Dressing	Freeport
6539	Hubbard's Bone Base Fertilizer for Seeding Down	Freeport
6314	Rogers and Hubbard's 4-8-4 Phosphate	Brunswick
6303	Rogers and Hubbard's 4-8-10 Phosphate	Freeport
6542	Rogers and Hubbard's 4-8-10 Phosphate	Brunswick
6304	Rogers and Hubbard's Potato Phosphate	Freeport

Analysis of Fertilizer Samples, 1922.

Station number	Water	Nitrogen				Phosphoric Acid				Potash	
				Total		Available		Total			
		As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6505	6.57	1.06	1.73	1.95	1.64	8.13	8.00	8.97	9.00	3.02	3.00
6489	4.87	0.78	1.45	1.67	1.64	8.20	8.00	8.74	9.00	1.89	2.00
6439	8.66	2.38	3.49	4.01	3.29	7.69	6.00	8.89	7.00	11.29	10.00
6430	6.70	1.94	3.05	4.09	4.11	8.27	8.00	10.90	8.00	7.38	7.00
6579	11.87	1.84	3.62	4.12	4.10	7.76	8.00	9.34	9.00	6.72	7.00
6565	8.28	1.86	2.87	3.27	3.28	8.21	8.00	9.56	9.00	4.21	4.00
6577	8.95	1.86	3.11	3.38	3.28	8.16	8.00	9.31	9.00	4.72	4.00
6578	10.21	1.98	3.07	3.34	3.28	7.98	8.00	9.05	9.00	7.94	7.00
6580	10.77	1.86	3.01	3.30	3.28	7.91	8.00	9.24	9.00	6.52	7.00
6576	5.82	2.10	3.06	3.38	3.28	5.23	6.00	6.28	7.00	12.44	10.00
6138	8.68	1.63	2.38	2.56	2.46	8.32	8.00	9.54	9.00	4.02	4.02
6136	7.18	1.02	2.27	2.53	2.46	6.74	6.00	7.81	9.00	7.47	10.00
6562	7.18	0.50	1.52	1.78	1.64	8.00	8.00	9.05	9.00	3.44	3.00
6283	6.77	2.12	3.65	4.07	4.10	8.46	8.00	8.80	9.00	7.32	7.00
6282	7.81	1.78	2.87	3.21	3.28	7.93	8.00	8.87	9.00	7.53	7.00
6280	5.88	1.84	3.04	3.32	3.28	6.22	6.00	6.83	7.00	10.63	10.00
6306	5.33	2.06	3.27	3.53	3.28	6.78	6.00	7.24	7.00	9.52	10.00
6281	9.46	1.38	2.44	2.71	2.45	8.95	8.00	9.82	9.00	4.11	4.00
6279	9.07	0.96	1.55	1.77	1.64	8.89	8.00	10.11	9.00	3.15	3.00
6507	10.44	--------	------	2.20	2.50	--------	0.50	1.19	1.00	3.91	2.50
6514	8.66	--------	------	2.08	2.06	--------	0.50	1.22	1.00	3.94	2.50
6302	9.53	0.34	0.83	1.05	0.82	10.38	10.00	11.83	11.00	2.99	3.00
6301	5.77	1.44	2.35	2.56	2.46	8.70	8.00	9.98	10.00	7.04	6.00
6540	7.35	7.72	8.41	8.56	8.22	4.71	3.00	7.68	8.00	7.87	8.00
6539	5.41	0.20	1.88	2.44	2.46	5.78	6.00	16.39	15.00	5.12	4.00
6314	9.16	2.98	3.43	3.59	3.29	8.98	8.00	10.18	9.00	4.18	4.00
6303	5.38	2.50	3.11	3.45	3.29	8.02	8.00	9.73	9.00	11.19	10.00
6542	6.87	2.70	3.26	3.45	3.29	7.77	8.00	9.63	9.00	9.99	10.00
6304	8.17	1.18	1.63	1.89	1.64	8.25	8.00	9.86	9.00	5.11	4.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
	SAGADAHOC FERTILIZER CO., BOWDOINHAM, MAINE.	
6300	Dirigo Fertilizer	Freeport
6309	Nitrate of Soda	Newport
6520	Nitrate of Soda	Lewiston
6516	Pure Animal Bone Meal	Lewiston
6478	Sagadahoc 5-8-7 Fertilizer	East Newport
6310	Sagadahoc 4-8-4 Fertilizer	Newport
6479	Sagadahoc 4-8-7	East Newport
6541	Sagadahoc 4-8-7 Fertilizer	Freeport
6312	Sagadahoc 4-6-10 Fertilizer	Newport
6517	Sagadahoc 4-6-10 Fertilizer	Lewiston
6515	Sagadahoc Sheep Manure	Lewiston
6311	Sagadahoc 3-10-3 Fertilizer	Newport
6518	Sagadahoc 3-10-3 Fertilizer	Lewiston
6519	Sagadahoc 2-10-2 Fertilizer for All Crops	Lewiston
6530	Sagadahoc 2-10-2 Fertilizer for All Crops	Yarmouth
	SUMMER'S FERTILIZER CO., BALTIMORE, MD.	
6401	Sumner's Potato Fertilizer	Houlton
	EARP THOMAS CULTURES CORP., NEW YORK.	
6272	Stem U-Plant	Portland
	I. P. THOMAS & SONS CO., PHILADELPHIA, PA.	
6444	High Grade Potato Manure 4-8-10	Unity
6417	I. P. Thomas 5-8-7 Fertilizer	Mars Hill
6445	Trucker's High Grade Guano 4-8-4	Unity
	UNITED STATES GUANO CO., BALTIMORE, MD.	
6384	Golden Rule Guano 4-6-10	Bangor
6380	Ground Fish 10%	Bangor
6382	Muriate of Potash	Bangor
6326	Nitrate of Soda	Waterboro
6364	Nitrate of Soda	Ellsworth
6381	Nitrate of Soda	Bangor
6295	Standard United States Evergreen Fish Guano	Biddeford
6327	Standard United States Evergreen Fish Guano	Waterboro
6368	Standard United States Evergreen Fish Guano	Ellsworth
6386	Standard United States Evergreen Fish Guano	Bangor
6293	Standard United States Fish, Bone and Potash	Biddeford
6325	Standard United States Fish, Bone and Potash	Waterboro
6369	Standard United States Fish, Bone and Potash	Ellsworth

Analysis of Fertilizer Samples, 1922.

		Nitrogen				Phosphoric Acid				Potash	
				Total		Available		Total			
Station number	Water	As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6300	7.40	1.94	2.41	2.47	2.47	9.15	5.00	10.27	10.00	4.03	3.00
6309	0.72	14.96	14.96	14.96	15.00						
6520	1.14	14.96	14.96	14.96	15.00						
6516	6.35	--------	------	1.31	1.50	--------	--------	31.69	27.00	--------	--------
6478	7.04	2.60	3.54	4.15	4.12	7.97	8.00	10.14	9.00	7.94	7.00
6310	7.54	2.00	2.84	3.28	3.29	8.23	8.00	9.89	9.00	4.37	4.00
6479	7.70	2.34	3.05	3.39	3.29	8.76	8.00	9.91	9.00	8.31	7.00
6541	9.41	2.30	2.72	3.34	3.29	8.42	8.00	9.34	9.00	8.20	7.00
6312	6.64	1.78	2.84	3.31	3.29	6.07	6.00	7.37	7.00	10.27	10.00
6517	7.80	1.90	2.88	3.32	3.29	5.83	6.00	7.36	7.00	10.22	10.00
6515	22.88	--------	------	1.09	1.50	--------	--------	0.70	3.00	0.48	1.25
6311	8.86	2.02	2.22	2.58	2.47	9.81	10.00	10.81	11.00	4.39	3.00
6518	10.60	1.66	2.18	2.44	2.47	10.12	10.00	11.22	11.00	3.33	3.00
6519	10.09	1.12	1.75	2.08	1.65	10.12	10.00	11.57	11.00	2.84	2.00
6530	10.05	0.64	1.48	1.83	1.65	9.75	10.00	11.03	11.00	1.87	2.00
6401	5.85	3.48	3.90	4.12	4.10	7.81	8.00	8.42	9.00	7.23	7.00
6272	1.37	11.16	11.16	11.33	11.00	11.07	--------	11.07	12.00	15.56	15.00
6444	6.98	2.26	2.94	3.32	3.25	8.39	8.00	9.21	8.50	10.05	10.00
6417	9.24	3.12	3.64	4.11	4.10	8.70	8.00	9.57	8.50	7.36	7.00
6445	8.85	2.16	2.82	3.34	3.25	8.33	8.00	9.50	8.50	4.58	4.00
6384	------	2.04	2.60	2.86	3.28	7.27	6.00	8.42	6.50	11.29	10.00
6380	7.28	--------	------	6.62	------	--------	--------	8.60	--------	--------	--------
6382	0.47	--------	------	------	------	--------	--------	--------	--------	47.12	50.00
6326	1.33	14.01	14.01	14.01	14.82						
6364	2.91	13.55	13.55	13.55	14.82						
6381	2.05	14.01	14.01	14.01	14.82						
6295	------	--------	------	3.30	3.28	8.08	8.00	9.76	8.50	4.23	4.00
6327	10.42	2.60	2.97	3.33	3.28	6.78	8.00	8.87	8.50	6.45	4.00
6368	8.57	2.26	2.75	3.14	3.28	8.70	8.00	9.92	8.50	5.27	4.00
6386	7.06	2.42	2.97	3.29	3.28	9.01	8.00	10.08	8.50	5.31	4.00
6293	9.85	3.18	3.79	4.05	4.10	8.31	8.00	9.76	8.50	7.30	7.00
6325	11.15	3.38	3.95	4.14	4.10	8.20	8.00	9.86	8.50	6.99	7.00
6369	9.54	2.30	2.78	2.98	4.10	10.55	8.00	11.52	8.50	5.77	7.00

Descriptive List of Fertilizer Samples, 1922.

Station number	Manufacturer, Place of Business and Brand.	Sample taken at
6346	Standard United States 16% High Grade Acid Phosphate	Waterboro
6367	Standard United States 16% Extra High Grade Acid Phosphate	Ellsworth
6383	Standard United States 16% Extra High Grade Acid Phosphate	Bangor
6296	Standard United States Golden Rule Guano	Biddeford
6328	Standard United States Golden Rule Guano	Waterboro
6370	Standard United States Golden Rule Guano	Ellsworth
6322	Standard United States Ideal Potato Grower	Waterboro
6297	Standard United States Special Potato Grower	Biddeford
6324	Standard United States Special Potato Grower	Waterboro
6366	Standard United States Special Potato Grower	Ellsworth
6385	Standard United States Special Potato Grower	Bangor
6323	Sulphate of Ammonia	Waterboro
6320	Sulphate of Potash	Waterboro
6365	United States Ideal Potato Grower	Ellsworth
	VIRGINIA-CAROLINA CHEMICAL CO., NEW YORK CITY.	
6412	V-C Aroostook Potato Grower	Houlton
6454	V-C Aroostook Potato Grower	Limestone
6501	V-C Challenge Brand	Buxton
6502	V-C Champion Brand	Buxton
6462	V-C Crescent Brand	Westfield
6503	V-C Crescent Brand	West Buxton
6413	V-C Double Owl Brand Fertilizer	Houlton
6553	V-C Owl Brand	Cumberland Ct.
6569	V-C Owl Brand	Augusta
6555	V-C Plow Brand	Cumberland Ct.
6504	V-C Universal Brand	West Buxton
6554	V-C Universal Brand	Cumberland Ct.
	WHITMAN AND PRATT RENDERING CO., BOSTON, MASS.	
6424	Whitman & Pratt's 5-8-7 Brand	Fort Fairfield
6484	Whitman & Pratt's 4-8-4 Brand	Berwick
6538	Whitman & Pratt Pure Ground Bone	Portland
6485	Whitman & Pratt's 2-8-2 Fertilizer	Berwick

Analysis of Fertilizer Samples, 1922.

		NITROGEN				PHOSPHORIC ACID				POTASH	
				Total		Available		Total			
Station number	Water	As nitrate and ammonia	Active	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
6346	9.45	------	------	------	------	17.22	16.00	17.86	16.50	------	------
6367	9.32	------	------	------	------	17.83	16.00	18.09	16.50	------	------
6383	8.62	------	------	------	------	18.40	16.00	18.50	16.50	------	------
6296	8.32	2.66	3.04	3.34	3.28	5.77	6.00	7.43	6.50	10.40	10.00
6328	8.70	2.58	3.11	3.34	3.28	6.27	6.00	7.81	6.50	10.52	10.00
6370	7.75	2.70	3.09	3.15	3.28	7.23	6.00	8.58	6.50	10.51	10.00
6322	11.18	2.48	3.06	3.27	3.28	7.65	8.00	9.44	8.50	6.46	6.00
6297	9.71	1.74	2.30	2.59	2.46	8.58	8.00	10.37	8.50	4.25	4.00
6324	11.10	1.72	2.42	2.84	2.46	7.96	8.00	10.31	8.50	4.38	4.00
6366	------	1.76	2.30	2.73	2.46	8.88	8.00	9.98	8.50	4.40	4.00
6385	6.27	1.94	2.28	2.58	2.46	8.14	8.00	9.19	8.50	5.28	4.00
6323	0.75	20.26	20.26	20.26	20.58						
6320	0.90	------	------	------	------	------	------	------	------	49.10	49.00
6365	10.34	2.32	3.02	3.26	3.28	10.22	8.00	11.29	8.50	5.37	6.00
6412	5.85	3.86	3.96	4.17	4.11	8.42	8.00	8.80	9.00	7.46	7.00
6454	5.94	3.82	3.97	4.16	4.11	8.57	8.00	9.31	9.00	6.69	7.00
6501	7.85	0.34	1.12	1.27	0.82	9.73	9.00	10.90	10.00	3.25	3.00
6502	7.36	2.68	3.25	3.60	3.29	8.51	8.00	8.89	9.00	4.92	4.00
6462	5.46	2.70	3.13	3.32	3.29	6.33	6.00	6.79	7.00	9.73	10.00
6503	3.80	2.76	3.11	3.30	3.29	6.60	6.00	6.98	7.00	10.79	10.00
6413	5.28	3.44	3.16	3.30	3.29	8.59	8.00	9.00	9.00	6.25	6.00
6553	10.02	1.36	1.66	1.76	1.65	8.83	8.00	9.95	9.00	3.14	3.00
6569	8.53	0.96	1.45	1.80	1.65	8.69	8.00	9.15	9.00	3.34	3.00
6555	7.21	0.76	0.86	1.02	0.82	8.16	8.00	9.18	9.00	1.28	1.00
6504	6.57	------	------	------	------	16.79	16.00	17.25	17.00	------	------
6554	8.97	------	------	------	------	16.08	16.00	16.41	17.00	------	------
6424	7.36	2.30	3.42	3.89	4.11	7.29	8.00	14.15	10.00	6.99	7.00
6484	6.00	1.66	2.95	3.28	3.29	7.44	8.00	14.04	10.00	4.18	4.00
6538	8.33	------	------	2.40	2.46	------	------	2672	22.00	------	------
6485	6.54	0.78	1.42	1.79	1.64	7.24	8.00	12.88	10.00	2.40	2.00

Table Showing the Results of Examination of Samples of Lime and Limestone Collected by the Inspectors in 1921-1922.

Station number	Name, Maker and Brand	Calcium oxide		Magnesium oxide		Fineness			
		Found	Claimed	Found	Claimed	Passed 20 mesh	Passed 40 mesh	Passed 60 mesh	Passed 80 mesh
	AROOSTOOK FEDERATION OF FARMERS, CARIBOU, ME.								
6400	Aroostook Farmers' Land Lime	49.36	------	0.86	------	99.0	83.0	63.0	60.0
	THE DOMINION LIME CO., SHERBROOKE, QUE., CAN.								
6305	Dudswell Brand Pulverized Agricultural Limestone	52.50	52.00	0.68	0.48	100.0	87.0	78.0	76.0
	PROVINCIAL LIME CO. LTD., ST. JOHN, N. B., CANADA								
6456	Pulverized Lime	51.39	50.40	1.38	------	100.0	69.0	48.0	42.0
	ROCKLAND & ROCKPORT LIME CORP., ROCKLAND, MAINE								
6286	R-R Land Lime	61.64	60.00	0.36	0.50	99.0	83.0	72.0	69.0
6335	R-R Land Lime	57.27	60.00	trace	0.50	98.0	83.0	72.0	67.0
	UNITED STATES GYPSUM CO., CHICAGO, ILL.								
6287	Ben Franklin Agricultural Gypsum Land Plaster	34.00	32.00	1.73	------	100.0	99.0	94.0	93.0
	HOWARD A. WILLARD CASWELL, MAINE								
6455	Ground Limestone	39.04	39.20	trace	------	95.0	56.0	42.0	39.0

December, 1922

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

ANALYSTS

James M. Bartlett

Elmer R. Tobey **Viola L. Morris***

C. Harry White

Official Inspections

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COMMERCIAL AGRICULTURAL SEEDS, 1922
INSECTICIDES AND FUNGICIDES, 1922

The Commissioner of Agriculture is the executive of the law regulating the sale of agricultural seeds, insecticides and fungicides in Maine. It is the duty of the Director of the Maine Agricultural Experiment Station to make analyses of the samples collected by the Commissioner, and to publish the results of the analyses together with the names of the persons from whom the samples were obtained, and such additional information as may seem advisable. All correspondence relative to the inspection laws should be addressed to the Bureau of Inspections, Department of Agriculture, Augusta, Maine.

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*Seed work.

COMMERCIAL AGRICULTURAL SEEDS, 1922*

THE LAW REGULATING THE SALE OF AGRICULTURAL SEEDS

The first law regulating the sale of agricultural seeds was enacted by the Legislature of 1897. This has been revised by the Legislature of 1905, 1911 and 1919. The following are the sections of the greatest importance to the dealer and the user of seeds. The most important changes made by the Legislature of 1919 are the declaration of noxious seeds and the vitality or germination guaranty required under section 3. As provided for under the inspection law, the Commissioner of Agriculture has proclaimed a list of seeds that will for the present be considered as noxious. This list is given on pages 79 and 80.

Section 2. The term "agricultural seed" as used in this chapter shall be held to include the seeds of alfalfa, barley, Canadian blue grass, Kentucky blue grass, brome grass, buckwheat, alsike clover, crimson clover, red clover, medium clover, white clover, field corn, Kaffir corn, meadow fescue flax, Hungarian, millet, oats, orchard grass, rape, redtop, rye, sorghum, timothy and wheat.

Section 3. Every lot or package of agricultural seed which is sold, distributed, transported, offered or exposed for sale, distribution or transportation for seed, in the state by any dealer in seed shall have affixed in a conspicuous place on the outside thereof, a plainly written or printed statement clearly and truly giving the name thereof and its minimum percentage of purity and freedom from foreign matter, together with the name and approximate amount of each kind of noxious weed seed contained therein, and also a guarantee of the germinating power of the seed and the date of the test for germination.

Section 12. For the purpose of this chapter an article shall be deemed to be adulterated:

In case of agrciultural seed:

First. If its purity falls below its accompanying guaranty.

Second. If it contains the seed of any poisonous plant, or any kind or amount of weed seed other than the kinds or amounts represented in the statement required by section three of this chapter.

Third. If it, upon test of germination made within six months of the date of test in statement under the provisions of section three herein above, does not show the same germinating power given in said statement prescribed by the provisions of said section three. Provided said seed has been constantly kept under conditions not injurious to its germinating qualities, and that a margin of tolerance of five per cent shall be allowed.

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*Compiled by W. J. Morse.

List of Noxious Weed Seeds Arranged Alphabetically by Common Names.

Ball Mustard (Neslia paniculata)
Bearded Darnel (Lolium temulentum)
Bitter Dock (Rumex obtusifolius)
Black Mustard (Brassica nigra)
Bladder Campion (Silene latifolia)
Blue Bur or Stickseed (Lappula echinata)
Blueweed (Echium vulgare)
Canada Thistle (Cirsium arvense)
Charlock (Brassica arvensis)
Chicory (Cichorium intybus)
Clover Dodder (Cuscuta species)
Clustered Dock (Rumex conglomeratus)
Common Ragweed (Ambrosia artemisiifolia)
Common (Annual) Sow Thistle (Sonchus oleraceus)
Corn Cockle (Agrostemma githago)
Cow-herb (Saponaria vaccaria)
Daisy Fleabane (Erigeron ramosus)
False Flax (Camelina sativa)
Field Bindweed (Convolvulus arvensis)
Field Penny Cress (Thlaspi arvense)
Field (Perrenial) Sow Thistle (Sonchus arvensis)
Great Ragweed (Ambrosit trifida)
Indian Mustard (Brassica juncea)
Hare's-Ear Mustard (Conringia orientalis)
King devil weed (Hieracium pratense)
Night-flowering Catchfly (Silene noctiflora)
Orange hawk weed (Hieracium aurantiacum)
Ox-eye Daisy (Crysanthemum leucanthemum)
Perennial Ragweed (Ambrosia psilostachya)
Ribgrass (Plantago lanceolata)
Rutabaga (Brassica campestris)
Small-seeded False Flax (Camelina microcarpa)
Spiny-leaved or Prickly Sow Thistle (Sonchus asper)
Sweet scabious (Erigeron annuus)
Tumble Mustard (Sisymbrium altissimum)
White Campion (Lychnis alba)
Wild Carrot (Daucus carota)
Wild Oats (Avena fatua)
Wild Radish (Raphanus raphanistrum)
Yellow Dock (Rumex crispus)

List of Noxious Weed Seeds Arranged Alphabetically by Scientific Names. (Gray's Manual 17th Edition, 1908).

Agrostemma githago. Corn Cockle.
Ambrosia artemisiifolia. Common Ragweed.
Ambrosia psilostachya. Perennial Ragweed.
Ambrosia trifida. Great Ragweed.
Avena fatua. Wild Oats.
Brassica arvensis. Charlock.
Brassica campestris. Rutabaga.
Brassica juncea. Indian Mustard.
Brassica nigra. Black Mustard.
Camelina microcarpa. Small-seeded False Flax.
Camelina sativa. False Flax.
Chrysanthemum leucanthemum. Ox-eye Daisy.
Cichorium intybus. Chicory.
Cirsium arvense. Canada Thistle.
Conringia orientalis. Hare's-Ear Mustard.
Convolvulus arvensis. Field Bindweed.
Cuscuta species. Clover Dodder.
Daucus carota. Wild Carrot.
Echium vulgare. Blueweed.
Erigeron annuus. Sweet scabious.
Erigeron ramosus. Daisy Fleabane.
Hieracium aurantiacum. Orange hawk weed.
Hieracium pratense. King devil weed.
Lappula echinata. Blue Bur or Stickseed.
Lychnis alba. White campion.
Lolium temulentum. Bearded Darnel.
Neslia paniculata. Ball Mustard.
Plantago lanceolata. Ribgrass.
Raphanus raphanistrum. Wild Radish.
Rumex conglomeratus. Clustered Dock.
Rumex crispus. Yellow dock.
Rumex obtusifolius. Bitter Dock.
Saponaria vaccaria. Cow-herb.
Silene Latifolia. Bladder Campion.
Silene noctiflora. Night-flowering Catchfly.
Sisymbrium altissimum. Tumble Mustard.
Sonchus asper. Spiny-leaved or Prickly Sow Thistle.
Sonchus arvensis. Field (Perennial) Sow Thistle.
Sonchus oleraceus. Common (Annual) Sow Thistle.
Thlaspi arvense. Field Penny Cress.

EXPLANATION OF TABLES

The seeds are arranged alphabetically by their common name, the samples are arranged alphabetically by the name of the town in which the sample was drawn. Each sample is reported on two pages.

The table at the left gives the Station number of the sample, the name of the town where the sample was taken, the name of the dealer from whom the sample was drawn and, when known, the source from which the dealer purchased.

The table on the right hand pages gives the Station number of the sample and the detailed guarantees and analyses. By means of the Station numbers the two tables are readily compared. On the right hand page the second column gives the guaranty of purity and the next column gives the percentage of purity as found by examination in the laboratory. The three following columns give the impurities found, telling how much of them are inert matter, such as dirt, hulls, etc., how much are harmless seeds as clover and desirable grasses and how much of the impurities are undesirable weed seeds.

The first column under noxious seeds shows whether or not noxious seeds were declared. The next column shows whether noxious seeds were found and if so their common name and approximate number per pound.

The three last columns on the right hand page have to do with the viability of the seed. The first column under germination gives the guaranty as fixed by the dealer. The second column gives the results of the analysis for germination.

The last column gives what is called the actual value. The figures in this column were obtained by multiplying the purity as found by the germination as found. Of course this product is not strictly accurate for the purity is found by weight and the germination by count. But it gives an approximate idea as to what part of the seed as purchased can be hoped to produce actual plants of the desired kind.

Descriptive List of Official Seed Samples, 1922.

Station number.	Kind of Seed. Name and Place of Business of Retailer and Jobber.
	ALSIKE CLOVER.
10159	Bangor. Thompson Implement & Seed Co. Whitney Eckstein Co., Buffalo, N. Y.
10190	Bridgton. Bridgton Farmers' Union. N. Wertheimer & Sons, Ligonier, Ind.
10184	Bridgton. Wales & Hamblen. Jos. Breck & Sons, Boston, Mass.
10242	Calais. Percy L. Lord. E. W. Conklin & Son, Binghamton, N. Y.
10230	Caribou. Caribou Grange Store. John Watson Co., Houlton, Maine.
10301	Columbia Falls. George L. Sinclair. Milwaukee Seed Co., Milwaukee, Wis.
10218	Fort Fairfield. Aroostook Farmers' Exchange. N. Wertheimer & Sons, Ligonier, Ind.
10219	Fort Fairfield. Aroostook Farmers' Exchange. N. Wertheimer & Sons, Ligonier, Ind.
10196	Houlton. Houlton Grange Store. N. Wertheimer & Sons, Ligonier, Ind.
10198	Houlton. Houlton Grange Store. John Watson Co., Houlton, Maine.
10201	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10203	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10205	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10293	Kingman. B. E. Lindsay. Whitney Eckstein Seed Co., Buffalo, N. Y.
10271	Lewiston. E. P. Ham. W. H. Morehouse & Co., Toledo, Ohio.
10258	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10164	Portland. E. W. Burbank Seed Co. Patrons Cooperative Corp., Portland, Me.
10140	Portland. Kendall & Whitney.
10227	Presque Isle. Aroostook Cooperative Co. Albert Dickinson Co., Chicago.
10221	Presque Isle. E. W. Fernald. Albert Dickinson Co., Chicago, Ill.
10288	Waterville. Central Maine Farmers' Exchange. N. Wertheimer & Sons, Ligonier, Ind.
	BARLEY.
10178	Harrison. Chapman Brothers. Albert Dickinson Co., Chicago, Ill.
10276	Lewiston. E. P. Ham. W. H. Morehouse & Co., Toledo, Ohio.
10277	Lewiston. E. P. Ham. Whitney Eckstein Seed Co., Buffalo, N. Y.
10171	Portland. E. W. Burbank Seed Co. Jos. Breck & Sons, Boston, Mass.
10147	Waterville. Gerrish & Smith. Whitney Eckstein Seed Co., Buffalo, N. Y.
	BUCKWHEAT (Japanese).
10146	Waterville. Gerrish & Smith. Whitney Eckstein Seed Co., Buffalo, N. Y.
	CORN.
10249	Berwick. A. D. Turgeon. Tioga Mill & Elevator Co., Sommersworth, N. H.
10253	Berwick. A. D. Turgeon. St. Albans Grain Co., St. Albans, Vt.

Results of Examination of Official Seed Samples, 1922.

	PURITY		IMPURITIES			NOXIOUS SEEDS		GERMINATION		
Station number.	Guaranty. %	Found. %	Inert Matter. %	Harmless Seeds. %	Weed Seeds. %	Declared?	Number Found in One Pound	Guaranty. %	Found. %	Actual Value. %
10159	97.0	96.1	0.93	2.20	0.78	No	Ribgrass 454, Night flowering catchfly 227	90.0	88.2	84.8
10190	96.0	97.1	0.60	0.40	1.90	No	Curled dock 3178, Night flowering catchfly 8626	91.0	89.5	86.9
10184	95.0	99.1	0.65	0.16	0.08	No	Night flowering catchfly 3632	91.0	84.7	84.0
10242	97.5	97.3	0.60	1.70	0.40	No	False flax 454	88.0	83.2	81.0
10230	99.1	99.4	0.20	0.15	0.20	No	Night flowering catchfly 908, Canada thistle 227, Curled dock 227	99.0	87.5	87.0
10301	97.5	89.6	1.05	7.25	2.10	No	Night flowering catchfly 2951, Canada thistle 227	94.0	81.7	73.2
10218	97.2	99.3	trace	0.10	0.60	No	Canada thistle 227, Night flowering catchfly 2043, Curled dock 227	91.0	89.5	88.8
10219	99.1	99.6	0.05	0.25	0.05	Yes	Night flowering catchfly 227, Curled dock 227	91.0	91.0	90.6
10196	98.7	99.0	0.10	0.10	0.80	No	Night flowering catchfly 3178	93.0	88.0	87.1
10198	98.1	98.8	0.15	0.80	0.20	No	Night flowering catchfly 908	92.0	85.7	84.7
10201	97.2	98.8	0.55	0.25	0.40	No	Night flowering catchfly 2497, Curled dock 227	80.0	84.0	82.9
10203	98.1	99.2	0.15	0.50	0.15	No	Night flowering catchfly 908, Dodder sp. 227	95.0	86.0	85.3
10205	94.5	97.3	0.70	1.10	0.90	No	Curled dock 454, night flowering catchfly 1362	91.0	86.2	83.9
10293	97.0	97.4	0.25	2.05	0.25	No	None	90.0	86.5	84.2
10271	97.7	97.9	1.10	0.90	0.10	No	Night flowering catchfly 681	90.0	86.5	84.6
10258	96.7	97.6	0.18	1.65	0.50	No	Night flowering catchfly 1362	92.0	88.2	86.1
10164	97.5	97.2	0.60	1.89	0.27	Yes	Curled dock 227, small seeded false flax 227	90.0	86.0	83.6
10140	00.0	96.4	0.30	2.46	0.35	No	Night flowering catchfly 4313	00.0	89.2	86.1
10227	99.0	98.8	1.15	trace		No	None	85.0	87.0	86.0
10221	99.2	99.7	0.10	0.10	0.05	No	Night flowering catchfly 227	90.0	93.5	93.2
10288	97.0	94.6	0.25	4.15	1.00	No	Night flowering catchfly 2724, Curled dock 227	90.0	88.0	83.2
10178	97.2	96.0	0.54	3.13	0.27	No	Wild oats 60	95.0	95.0	91.2
10276	98.0	98.5	0.48	0.92	0.06	No	None	97.0	97.0	95.5
10277	98.0	98.1	0.72	1.08	0.10	No	Great Ragweed 15, Corn Cockle 15, Rutabaga 15	90.0	92.0	90.2
10171	97.0	99.3	0.21	0.45	trace	No	None	92.0	77.5	76.9
10147	00.0	98.7	0.59	0.63	0.04	Yes	Wild oats 15	90.0	95.0	93.8
10146	00.0	92.2	0.57	6.93	0.30	Yes	Perennial ragweed 210	90.0	89.5	82.5
10249	99.8	99.7	0.30	0.00	0.00	Yes	None	90.0	98.0	97.7
10253	99.0	99.5	0.50	0.00	0.00	No	None	90.0	96.0	95.5

Descriptive List of Official Seed Samples, 1922.

Station number.	Kind of Seed. Name and Place of Business of Retailer and Jobber.
10243	Calais. Percy L. Lord. Jerome B. Rice Seed Co., Cambridge, N. Y.
10282	Charleston. Charleston Farm Bureau. Edward F. Dibble, Honeoye Falls, N. Y.
10280	Hermon. C. E. Goodspeed. Edward F. Dibble, Honeoye Falls, N. Y.
10281	Levant. Levant Farm Bureau. Jos. Harris Co., Coldwater, N. Y.
10279	Lewiston. E. P. Ham. Albert Dickinson Co., Chicago, Ill.
10264	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10265	Lewiston. Haskell Implement & Seed Co. C. S. Ordway, West Newbury, Mass.
10266	Lewiston. Haskell Implement & Seed Co. H. P. Baker & Co., Columbia, Va.
	HUNGARIAN.
10246	Berwick. Berwick Farmers' Union. Kendall & Whitney, Portland, Maine
10192	Bridgton. Bridgton Farmers' Union. N. Wertheimer & Sons, Ligonier, Ind.
10180	Harrison. Chapman Bros. Kendall & Whitney, Portland, Maine
10175	Harrison. F. C. Greene. Haskell Implement & Seed Co., Lewiston, Maine
10275	Lewiston. E. P. Ham. Whitney Eckstein Seed Co., Buffalo, N. Y.
10260	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10166	Portland. E. W. Burbank Seed Co. Patrons Cooperative Corp., Portland, Me.
10142	Portland. Kendall & Whitney
10289	Waterville. Central Maine Farmers' Exchange. N. Wertheimer & Sons, Ligonier, Ind.
	JAPANESE MILLET.
10247	Berwick. Berwick Farmers' Union. Kendall & Whitney, Portland, Maine
10189	Bridgton. Bridgton Farmers' Union. N. Wertheimer & Sons, Ligonier, Ind.
10186	Bridgton. Wales & Hamblen. Kendall & Whitney, Portland, Me.
10179	Harrison. Chapman Bros. Kendall & Whitney, Portland, Maine
10274	Lewiston. E. P. Ham. Whitney Eckstein Seed Co., Buffalo, N. Y.
10167	Portland. E. W. Burbank Seed Co. Patrons Cooperative Corp., Portland, Me.
10148	Waterville. G. A. Kennison Co. Haskell Implement & Seed Co., Lewiston, Me.
	KENTUCKY BLUEGRASS.
10256	Lewiston. Haskell Implement & Seed Co. Barber & Bennett, Albany, N. Y.
	MAMMOTH CLOVER.
10232	Caribou. Caribou Grange Store. John Watson Co., Houlton, Maine
10220	Fort Fairfield. Aroostook Farmers' Exchange. N. Wertheimer & Sons, Ligonier, Ind.
10215	Fort Fairfield. Stewart & Ginn. Oscar Holway Co., Auburn, Maine

Results of Examination of Official Seed Samples, 1922.

	PURITY		IMPURITIES			NOXIOUS SEEDS		GERMINATION		
Station number.	Guaranty. %	Found. %	Inert Matter. %	Harmless Seeds. %	Weed Seeds. %	Declared?	Number Found in One Pound	Guaranty. %	Found. %	Actual Value. %
10243	95.0	96.0	4.00	0.00	0.00	No	None	92.0	84.5	81.1
10282	99.0	99.0	trace	0.00	0.00	No	None	90.0	94.5	93.5
10280	99.0	99.0	trace	0.00	0.00	No	None	90.0	95.5	94.5
10281	00.0	100.0	0.00	0.00	0.00	No	None	100.0	96.5	96.5
10279	99.5	100.0	trace	0.00	0.00	No	None	96.0	93.0	93.0
10264	99.5	100.0	trace	0.00	0.00	No	None	97.0	91.0	91.0
10265	99.5	99.5	0.50	0.00	0.00	No	None	95.0	94.5	94.0
10266	99.5	99.5	0.50	0.00	0.00	No	None	95.0	92.5	92.0
10246	99.5	99.6	0.12	0.00	0.21	No	Great ragweed 135	93.0	96.0	95.6
10192	98.6	99.0	0.06	0.89	0.03	No	Ragweed 182, Curled dock 91	95.0	89.5	88.6
10180	99.5	99.6	0.14	0.05	0.20	No	Ragweed 90	93.0	92.5	92.1
10175	98.7	97.8	0.37	0.16	1.65	No	Ragweed 135, Indian mustard 45	92.0	81.5	79.7
10275	98.0	98.4	0.36	0.00	1.20	No	Canada thistle 45	88.0	86.0	84.6
10260	99.6	99.7	0.14	0.00	0.13	No	None	88.0	83.5	83.2
10166	98.0	97.7	0.26	0.06	1.96	Yes	Curled dock 45, Ragweed 45, Night flowering catchfly 45	93.0	85.5	83.5
10142	00.0	99.0	0.23	0.02	0.71	No	Ragweed 90	00.0	68.7	68.0
10289	98.6	99.3	0.15	0.00	0.51	No	Common ragweed 180	95.0	84.0	83.4
10247	98.0	99.6	0.25	0.00	0.15	No	Great ragweed 135	90.0	90.5	90.1
10189	98.2	96.9	0.42	0.20	2.40	No	Ragweed 273	93.0	93.5	90.6
10186	98.7	99.4	0.30	0.08	0.14	No	None	90.0	87.5	87.0
10179	98.0	99.2	0.44	0.00	0.30	No	Ragweed 45	90.0	88.5	87.8
10274	97.0	97.5	1.00	0.01	1.49	No	None	90.0	66.0	64.3
10167	98.0	97.7	0.99	0.00	1.26	Yes	Perennial ragweed 90, common ragweed 45	92.0	88.0	86.0
10148	97.0	96.9	0.66	0.07	2.36	Yes	Ragweed 360	92.0	96.0	93.0
10256	75.0	91.4	8.00	0.30	0.30	Yes	Curled dock 908, Ribgrass 454	67.0	41.5	37.9
10232	99.5	99.8	0.04	0.00	0.10	No	None	96.0	92.5	92.3
10220	99.6	99.6	0.28	0.00	0.08	Yes	Curled dock 91	92.0	91.0	90.6
10215	99.2	99.1	0.25	0.05	0.60	No	Common ragweed 182, curled dock 182	96.0	95.5	94.6

Descriptive List of Official Seed Samples, 1922.

Station number.	Kind of Seed. Name and Place of Business of Retailer and Jobber.
10200	Houlton. Houlton Grange Store. John Watson Co., Houlton, Maine
10202	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10257	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10137	Portland. Allen, Sterling & Lothrop
10226	Presque Isle. Aroostook Cooperative Co. N. Wertheimer & Sons, Ligonier, Ind.
	MIXTURES.
10298	Columbia Falls. George L. Sinclair. Milwaukee Seed Co., Milwaukee, Wis.
10300	Columbia Falls. George L. Sinclair. Milwaukee Seed Co., Milwaukee, Wis.
10172	Portland. E. W. Burbank Seed Co. Nungesser Dickinson Seed Co., N. Y.
10173	Portland. E. W. Burbank Seed Co. Nungesser Dickinson Seed Co., N. Y.
	OATS.
10248	Berwick. A. D. Turgeon. St. Albans Grain Co., St. Albans, Vt.
10181	Bridgton. Wales Hamblen Co. W. H. Morehouse & Co., Toledo, Ohio
10145	Caribou. G. B. Buck
10284	Lewiston. N. Beauregard Co. J. B. Ham Co., Lewiston, Maine
10267	Lewiston. E. P. Ham. W. H. Morehouse & Co., Toledo, Ohio
10143	Lewiston. Haskell Implement & Seed Co.
10263	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10144	Portland. F. A. Waldron & Son
10291	Portland. F. A. Waldron & Son
10287	Waterville. Gerrish & Smith. The Holbrook Grocery Co., Waterville
	RAPE.
10170	Portland. E. W. Burbank Seed Co. Jos. Breck & Sons, Boston, Mass.
	RED CLOVER, MEDIUM CLOVER.
10161	Bangor. Thompson Implement & Seed Co. Whitney Eckstein Co., Buffalo, N. Y.
10191	Bridgton. Bridgton Farmers' Union. N. Wertheimer & Sons, Ligonier, Ind.
10183	Bridgton. Wales & Hamblen. Kendall & Whitney, Portland, Maine
10231	Caribou. Caribou Grange Store. John Watson Co., Houlton, Maine
10237	Caribou. Milton Poland & Bishop. Albert Dickinson Co., Chicago, Ill.

Results of Examination of Official Seed Samples, 1922.

	PURITY		IMPURITIES			NOXIOUS SEEDS		GERMINATION		
Station number.	Guaranty. %	Found. %	Inert Matter. %	Harmless Seeds. %	Weed Seeds. %	Declared?	Number Found in One Pound	Guaranty. %	Found. %	Actual Value. %
10200	99.5	99.6	0.22	0.02	0.16	No	Ribgrass 91	96.0	92.5	92.1
10202	99.0	99.4	0.30	0.06	0.18	No	Night flowering catchfly 91, clover dodder 91, common ragweed 91, curled dock 182, bitter dock 91	94.0	84.5	84.0
10257	98.0	98.4	0.66	0.30	0.60	Yes	Curled dock 182	96.0	95.5	94.0
10137	00.0	98.3	0.10	1.04	0.48	No	Dock 273, Dodder 91, Russian thistle 91	00.0	91.5	90.0
10226	99.6	99.6	0.25	0.07	0.03	No	None	93.0	94.5	94.1
10298	00.0	86.1	5.32	3.56	5.00	No	Bladder campion 273, night flowering catchfly 1092, Ribgrass 2002, yellow dock 1092, bitter dock 728, dodder 182, Canada thistle 91	00.0	44.0	37.8
10300	00.0	84.4	7.57	1.30	6.67	No	Ribgrass 453, ox-eye daisy 302, Canada thistle 151, tumble mustard 6342, curled dock 302, Rutabaga 151, Bitter dock 453, common ragweed 302	00.0	69.7	
10172	0.00	71.0	25.46	0.26	3.06	Yes	Ribgrass 681, false flax 227, night flowering catchfly 227, daisy fleabane 681	00.0	75.7	
10173	0.00	82.3	17.05	0.00	0.45	Yes	None	00.0	77.5	
10248	99.0	98.6	0.44	0.26	0.66	No	Curled dock 15, charlock 45, wild oat 105	97.0	96.0	94.6
10181	98.5	97.9	0.22	1.23	0.56	Yes	Wild oat 90, Rutabaga 105	95.0	97.0	95.0
10145	00.0	99.0	0.80	0.13	0.00	No	None	00.0	97.5	96.5
10284	97.0	99.0	0.49	0.29	0.20	No	Wild oat 45, Rutabaga 30	95.0	91.0	90.1
10267	98.0	97.2	0.43	1.50	0.78	Yes	Wild oat 135, Rutabaga 60	97.0	89.5	87.0
10143	00.0	99.0	0.95	0.00	0.01	No	None	00.0	54.0	53.4
10263	99.0	99.3	0.23	0.37	0.06	No	Charlock 15	90.0	89.5	88,9
10144	00.0	98.6	0.87	0.40	0.06	No	Dock 15	00.0	86.0	84.8
10291	00.0	98.4	0.74	0.42	0.35	No	None	00.0	90.5	89.1
10287	99.0	99.2	0.11	0.43	0.17	No	Wild oat 30	97.0	96.5	95.8
10170	98.0	99.7	0.30	0.00	0.00	No	None	92.0	90.0	89.7
10161	98.0	97.8	0.46	0.32	1.36	No	Ribgrass 819, curled dock 182, ragweed 182	90.0	92.5	90.5
10191	99.5	98.5	0.24	0.00	1.20	No	Ribgrass 273, Night flowering catchfly 91, bitter dock 182	92.0	95.0	93.6
10183	98.0	94.6	0.84	0.15	4.41	No	Ribgrass 182, night flowering catchfly 182, curled dock 182	91.0	87.0	82.3
10231	99.5	99.9	0.04	0.00	0.04	No	None	94.0	88.5	88.4
10237	99.4	99.4	0.32	0.02	0.26	No	Ribgrass 182	95.0	89.5	88.9

Descriptive List of Official Seed Samples, 1922.

Station number.	Kind of Seed. Name and Place of Business of Retailer and Jobber.
10302	Columbia Falls. George L. Sinclair. Milwaukee Seed Co., Milwaukee, Wis.
10213	Fort Fairfield. Stewart & Ginn. Oscar Holway Co., Auburn, Me.
10216	Fort Fairfield. Stewart & Ginn. Oscar Holway Co., Auburn, Me.
10217	Fort Fairfield. Stewart & Ginn. Oscar Holway Co., Auburn, Me.
10198	Hiram. L. Cotton & Son. Kendall & Whitney Co., Portland, Maine.
10197	Houlton. Houlton Grange Store. Albert Dickinson Co., Chicago, Ill.
10204	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10206	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10208	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10294	Kingman. B. E. Lindsey. Whitney Eckstein Seed Co., Buffalo, N. Y.
10269	Lewiston. E. P. Ham. W. H. Morehouse & Co., Toledo, Ohio.
10270	Lewiston. E. P. Ham. Milwaukee Seed Co., Milwaukee, Wis.
10259	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10239	Limestone. G. P. Hamilton. Whitney Eckstein Seed Co., Buffalo, N. Y.
10240	Limestone. G. P. Hamilton. Whitney Eckstein Seed Co., Buffalo, N. Y.
10138	Portland. Allen, Sterling & Lothrop.
10165	Portland. E. W. Burbank Seed Co. Patrons Cooperative Corp., Portland, Me.
10141	Portland. Kendall & Whitney.
10225	Presque Isle. Aroostook Cooperative Co. Albert Dickinson Co., Chicago, Ill.
10228	Presque Isle. Aroostook Cooperative Co. N. Wertheimer & Sons, Ligonier, Ind.
10223	Presque Isle. E. W. Fernald. Albert Dickinson Co., Chicago, Ill.
10150	Waterville. G. A. Kennison Co. Haskell Implement & Seed Co., Lewiston, Me.
	REDTOP.
10163	Bangor. Thompson Implement & Seed Co. Whitney Eckstein Co., Buffalo, N. Y.
10252	Berwick. A. D. Turgeon. Whitney Eckstein Seed Co., Buffalo, N. Y.
10187	Bridgton. Bridgton Farmers' Union. N. Wertheimer & Sons, Ligonier, Ind.
10185	Bridgton. Wales & Hamblen. Kendall & Whitney, Portland, Maine.
10244	Calais. Percy L. Lord. E. W. Conklin & Son, Binghamton, N. Y.
10176	Harrison. Chapman Brothers. Kendall & Whitney, Portland, Maine.
10268	Lewiston. E. P. Ham. W. H. Morehouse & Co., Toledo, Ohio.
10285	Lewiston. J. B. Ham Co. Albert Dickinson Co., Chicago, Ill.
10158	Portland. Allen, Sterling & Lothrop.
10168	Portland. E. W. Burbank Seed Co. Patrons Cooperative Corp., Portland, Me.
10255	Sanford. S. J. Nowell. Kendall & Whitney, Portland, Maine.
10151	Waterville. G. A. Kennison. Whitney Eckstein Seed Co., Buffalo, N. Y.

Results of Examination of Official Seed Samples, 1922.

	PURITY		IMPURITIES			NOXIOUS SEEDS		GERMINATION		
Station number.	Guaranty. %	Found. %	Inert Matter. %	Harmless Seeds. %	Weed Seeds. %	Declared?	Number Found in One Pound	Guaranty. %	Found. %	Actual Value. %
10302	00.0	95.6	0.60	0.90	2.90	No	Dodder 182, yellow dock 91, ribgrass 91, rutabaga 91	00.0	88.5	84.6
10213	99.5	99.5	0.26	0.00	0.20	No	Ribgrass 91, dodder sp. 91, curled dock 91	97.0	93.0	92.5
10216	96.4	99.8	0.08	0.00	0.10	No	None	92.0	93.5	93.3
10217	00.0	99.2	0.26	0.00	0.50	Yes	Ribgrass 182	00.0	88.5	87.8
10193	99.2	99.4	0.10	0.03	0.43	No	Ribgrass 182, curled dock 91	82.0	89.5	89.0
10197	99.0	99.7	0.00	0.01	0.23	No	Ribgrass 182, Dodder 91, night flowering catchfly 91	94.0	93.0	92.7
10204	98.4	99.7	0.12	0.00	0.16	Yes	Ribgrass 273	90.0	90.0	89.7
10206	99.0	99.5	0.24	0.00	0.20	Yes	Curled dock 91, ragweed 182	95.0	86.0	85.6
10208	99.5	99.8	0.10	0.00	0.10	No	Ribgrass 273	94.0	90.5	90.3
10294	98.0	98.3	0.10	0.06	1.50	No	Common ragweed 91, ribgrass 182	90.0	93.5	91.9
10269	98.0	99.4	0.42	0.06	0.06	No	Dodder sp. 182	90.0	83.0	82.5
10270	98.0	98.9	0.08	0.56	0.46	No	Clover dodder 91	00.0	94.5	93.4
10259	97.6	98.8	0.24	0.40	0.56	No	Curled dock 91, charlock 91	94.0	91.0	89.9
10239	99.5	99.6	0.26	0.03	0.02	No	Curled dock 91	90.0	95.5	95.2
10240	98.0	98.3	0.72	0.26	0.64	No	Ribgrass 1365, chicory 91, bitter dock 182	90.0	85.0	83.6
10138	00.0	98.3	trace	1.00	0.67	No	Bitter dock 91, dodder 91	00.0	91.0	89.4
10165	99.0	99.0	0.46	0.06	0.42	Yes	Ragweed 91, bitter dock 91	90.0	83.0	82.2
10141	00.0	92.9	1.02	1.62	4.44	No	Curled dock 180, Russian thistle 45, dodder 90, ribgrass 135, night flowering catchfly 45	00.0	85.7	79.6
10225	99.6	99.8	0.10	0.01	0.01	No	Dodder sp. 91	95.0	93.0	92.8
10228	99.7	99.8	0.02	0.18	0.00	No	Curled dock 91	94.0	94.0	93.8
10223	99.0	99.4	0.28	0.23	0.03	No	Curled dock 91, common ragweed 91	93.0	85.5	85.0
10150	99.5	99.6	0.10	0.04	0.18	No	None	94.0	88.0	87.7
10163	90.0	89.1	8.78	0.35	1.73	No	Daisy fleabane 2270	90.0	83.2	74.2
10252	90.0	92.3	5.30	2.10	0.30	No	None	90.0	57.5	53.0
10187	93.6	92.5	6.00	0.00	1.50	No	Daisy fleabane 454	90.0	85.2	78.8
10185	90.0	89.4	8.00	0.00	2.60	No	None	83.0	84.0	75.1
10244	96.0	90.9	3.10	5.20	0.80	Yes	None	86.0	64.7	58.8
10176	85.0	90.2	7.50	1.40	0.90	No	None	85.0	70.7	63.8
10268	93.0	92.1	5.60	1.60	0.70	No	None	85.0	31.7	29.2
10285	90.7	91.6	7.10	0.00	1.30	No	Ox-eye daisy 454	91.0	78.2	71.6
10158	00.0	95.4	4.48	0.00	0.00	No	None	00.0	82.2	78.4
10168	91.5	92.3	5.87	0.02	1.78	Yes	Daisy fleabane 1362	93.0	82.7	76.4
10255	89.5	90.1	8.90	0.95	0.05	No	None	90.0	80.5	72.5
10151	90.0	92.4	6.09	0.02	1.38	No	None	00.0	80.2	74.1

Descriptive List of Official Seed Samples, 1922.

Station number.	Kind of Seed. Name and Place of Business of Retailer and Jobber.
	SPRING WHEAT.
10278	Lewiston. E. P. Ham. Whitney Eckstein Seed Co., Buffalo, N. Y.
	SWEET CLOVER.
10162	Bangor. Thompson Implement & Seed Co. Whitney Eckstein Co., Buffalo, N. Y.
10229	Presque Isle. Aroostook Cooperative Co. N. Wertheimer & Sons, Ligonier, Ind.
	TIMOTHY.
10160	Bangor. Thompson Implement & Seed Co. Whitney Eckstein Co., Buffalo, N. Y.
10245	Berwick. Berwick Farmers' Union. Kendall & Whitney, Portland, Maine
10250	Berwick. A. D. Turgeon. Craver Dickinson Seed Co. Inc., Buffalo, N. Y.
10251	Berwick. A. D. Turgeon. Craver Dickinson Seed Co. Inc., Buffalo, N. Y.
10188	Bridgton. Bridgton Farmers' Union. N. Wertheimer & Sons, Ligonier, Ind.
10182	Bridgton. Wales & Hamblen. Kendall & Whitney Co., Portland, Maine
10241	Calais. Percy L. Lord. E. W. Conklin & Son, Binghamton, N. Y.
10235	Caribou. Briggs Hardware Co. Whitney Eckstein Seed Co., Buffalo, N. Y.
10233	Caribou. Caribou Grange Store. John Watson Co., Houlton, Maine
10234	Caribou. Caribou Grange Store. John Watson Co., Houlton, Maine
10236	Caribou. Milton Poland & Bishop. Albert Dickinson Co., Chicago, Ill.
10238	Caribou. Milton Poland & Bishop. Albert Dickinson Co., Chicago, Ill.
10299	Columbia Falls. George L. Sinclair. Milwaukee Seed Co., Milwaukee, Wis.
10290	Ellsworth. C. W. Grindal Co. Oscar Holway Co., Auburn, Maine
10214	Fort Fairfield. Stewart & Ginn. Oscar Holway Co., Auburn, Maine
10177	Harrison. Chapman Brothers. Kendall & Whitney, Portland, Maine
10174	Harrison. F. C. Greene. Haskell Implement & Seed Co., Lewiston, Me.
10194	Hiram. L. Cotton & Son. Kendall & Whitney, Portland, Maine
10195	Houlton. Houlton Grange Store. N. Wertheimer & Sons, Ligonier, Ind.
10199	Houlton. Houlton Grange Store. John Watson Co., Houlton, Maine
10207	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10209	Houlton. John Watson Co., Albert Dickinson Co., Chicago, Ill.
10210	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10211	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10212	Houlton. John Watson Co. Albert Dickinson Co., Chicago, Ill.
10292	Kingman. B. E. Lindsay. Whitney Eckstein Seed Co., Buffalo, N. Y.
10283	Lewiston. N. Beauregard Co. Haskell Implement & Seed Co., Lewiston, Me.
10272	Lewiston. E. P. Ham. W. H. Morehouse & Co., Toledo, Ohio
10273	Lewiston. E. P. Ham. Milwaukee Seed Co., Milwaukee, Wis.
10286	Lewiston. J. B. Ham. Albert Dickinson Co., Chicago, Ill.
10261	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.
10262	Lewiston. Haskell Implement & Seed Co. Albert Dickinson Co., Chicago, Ill.

Results of Examination of Official Seed Samples, 1922.

	PURITY		IMPURITIES			NOXIOUS SEEDS		GERMINATION		
Station number.	Guaranty. %	Found. %	Inert Matter. %	Harmless Seeds. %	Weed Seeds. %	Declared?	Number Found in One Pound	Guaranty. %	Found. %	Actual Value. %
10278	98.0	98.6	1.25	0.00	0.07	No	None	80.0	95.0	93.7
10162	98.0	98.7	1.00	0.00	0.24	No	None	88.0	90.0	88.8
10229	99.2	99.5	0.44	0.00	0.02	No	None	95.0	85.5	85.1
10160	99.5	99.7	0.27	0.01	0.01	No	None	90.0	87.0	86.5
10245	99.6	99.9	0.05	0.00	0.05	No	None	95.0	94.0	93.9
10250	99.6	99.8	0.10	0.00	0.03	No	None	92.0	75.0	74.9
10251	99.6	99.6	0.13	0.15	0.03	Yes	None	90.0	87.2	86.9
10188	99.6	99.7	0.04	0.00	0.20	No	None	95.0	88.7	88.5
10182	99.6	99.9	0.05	0.00	0.03	No	None	95.0	91.0	90.9
10241	99.6	99.8	0.03	0.08	0.05	Yes	None	90.0	83.7	83.6
10235	99.5	99.7	0.15	0.00	0.10	No	None	90.0	91.5	91.2
10233	99.6	99.7	0.15	0.00	0.17	No	None	94.0	84.5	84.2
10234	99.8	100.0	trace	trace		No	None	96.0	91.0	91.0
10236	99.8	99.9	0.10	trace		No	None	95.0	89.5	89.4
10238	99.6	99.8	0.15	0.00	0.05	No	None	93.0	86.2	86.0
10299	98.0	91.2	4.35	2.50	1.95	No	Ox-eye daisy 454	92.0	82.2	75.0
10290	99.6	99.8	0.10	0.00	0.05	No	None	94.0	88.7	88.6
10214	99.6	99.8	0.15	0.00	0.00	No	None	94.0	82.5	82.3
10177	99.6	99.4	0.33	0.25	0.01	No	None	95.0	91.0	90.4
10174	99.6	99.6	0.19	0.21	0.09	No	None	95.0	97.5	97.1
10194	98.0	98.2	0.76	0.73	0.22	Yes	Ribgrass 227	90.0	80.5	79.1
10195	99.7	99.8	0.10	0.00	0.05	Yes	None	96.0	87.0	86.8
10199	99.6	99.8	0.15	0.00	0.05	No	None	92.0	88.7	88.5
10207	99.5	99.9	0.05	0.05	0.03	No	None	92.0	91.0	90.9
10209	99.6	99.8	0.15	0.00	0.05	No	None	95.0	88.2	88.0
10210	99.8	99.6	0.05	0.00	0.35	No	None	97.0	88.2	87.9
10211	98.0	98.7	0.75	0.50	0.05	No	None	86.0	83.7	82.6
10212	99.6	99.8	0.10	0.00	0.10	No	None	94.0	90.0	89.8
10292	99.5	99.5	0.40	0.00	0.05	No	None	90.0	82.2	81.8
10283	99.6	99.7	0.15	0.00	0.10	No	None	95.0	97.2	97.0
10272	99.5	99.2	0.15	0.60	0.03	No	None	90.0	94.5	93.7
10273	99.5	99.8	0.15	0.00	0.05	No	None	90.0	93.2	93.0
10286	98.0	98.8	0.85	0.25	0.10	No	None	95.0	87.0	85.9
10261	98.2	98.2	1.05	0.55	0.20	No	None	92.0	84.0	82.4
10262	99.6	99.8	0.03	0.00	0.08	Yes	None	95.0	93.7	93.6

Descriptive List of Official Seed Samples, 1922.

Station number.	Kind of Seed. Name and Place of Business of Retailer and Jobber.
10136	Portland. Allen, Sterling & Lothrop
10139	Portland. Allen, Sterling & Lothrop
10169	Portland. E. W. Burbank Seed Co. Patrons Cooperative Corp., Portland, Me.
10224	Presque Isle. Aroostook Cooperative Co. Albert Dickinson Co., Chicago, Ill.
10222	Presque Isle. E. W. Fernald. Albert Dickinson Co., Chicago, Ill.
10254	Sanford. S. J. Nowell. Kendall & Whitney Co., Portland, Maine
10149	Waterville G. A. Kennison Co. Haskell Implement & Seed Co., Lewiston

Results of Examination of Official Seed Samples, 1922.

	PURITY		IMPURITIES			NOXIOUS SEEDS		GERMINATION		
Station number.	Guaranty. %	Found. %	Inert Matter. %	Harmless Seeds. %	Weed Seeds. %	Declared?	Number Found in One Pound	Guaranty. %	Found. %	Actual Value. %
10136	00.0	99.6	0.10	0.00	0.10	No	None	00.0	90.5	90.1
10139	00.0	99.5	0.45	0.00	0.01	No	None	00.0	76.2	75.9
10169	99.6	99.4	0.28	0.19	0.10	Yes	None	95.0	91.5	90.9
10224	99.6	99.8	0.15	0.03	0.02	No	None	93.0	93.0	92.8
10222	99.6	99.9	0.05	0.00	0.05	No	None	95.0	92.0	91.9
10254	99.6	99.8	0.15	0.00	0.05	No	None	95.0	91.5	91.3
10149	99.6	99.6	0.10	0.20	0.03	No	None	95.0	94.0	93.6

INSECTICIDES AND FUNGICIDES 1922.*

REQUIREMENTS OF THE LAW.

The law regulating the sale of fungicides and insecticides was enacted by the Legislature of 1911. The scope of the law is the same as the National Law. It is very broad and includes all materials which are used for preventing, destroying, repelling or mitigating fungi and insects that infest vegetation, man and other animals, or houses, or any environment whatever.

Every lot or package shall be plainly marked with the number of net pounds in the package, the name or trademark under which the article is sold, the name and address of the manufacturer or shipper, the minimum percentage of total arsenic and the maximum percentage of water soluble arsenic.

Before a fungicide or insecticide can be lawfully sold in the State it is necessary that it be registered and for that purpose there must be deposited with the Commissioner of Agriculture a certified copy of the statements named above, a registration fee of $10.00, and, if the commissioner requires, a sample of the fungicide or insecticide.

The registration fee is not assessed on a brand consisting of organic matter and not containing any added inorganic matter or mineral chemical provided that a complete chemical analysis is given in, and as a part of, the required certificate.

RESULTS OF ANALYSES.

On the pages which follow are given the results of the analyses of all samples received from the Commissioner of Agriculture in 1922. The guarantees for arsenic given by manufacturers are expressed in different ways, viz. as metallic arsenic, arsenious oxide or arsenic oxide. These oxides are 75.8 and 65.2 per cent respectively, metallic arsenic. As the metallic arsenic is the poisonous principle of the arsenical compounds the amount contained in each brand is given in one column of the tables for convenience in comparing different kinds of goods. The analyses are arranged alphabetically according to the manufacturers or jobbers.

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*Prepared by James M. Bartlett.

PARIS GREEN

All Paris Greens are Guaranteed 50% Arsenious Oxide and not Over 3½% Water Soluble.

Station number.	Name and Address of Manufacturer or Jobber and Trade Name or Brand	Town Where Collected	Arsenious Oxide		Total Metallic Arsenic Found Per cent
			Total Found Per cent	Water Soluble Found Per cent	
30621	Ansbacher Insecticide Co., New York, N. Y. Ansbacher Paris Green	Skowhegan	57.3	2.46	43.40
30615	Bowker Insecticide Co., New York, N. Y. Bowkers' Paris Green	Old Town	57.2	3.00	43.33
30617	Devoe & Reynolds Co., New York, N. Y. Paris Green	Old Town	57.0	3.00	43.20
30595	John Lucas & Co., Boston, Mass. Paris Green	Bangor	55.4	1.55	41.97
30594	Nitrate Agencies Co., New York, N. Y. NACO Paris Green	Bangor	57.3	1.55	43.40
30608	Snow & Neally, Bangor, Maine Rogers' Paris Green	Wytopitlock	55.3	2.55	41.90
30600	The Sherwin-Williams Co., Cleveland, Ohio Paris Green	Bangor	56.1	1.82	42.50

CALCIUM ARSENATE

Station number.	Name and Address of Manufacturer or Jobber and Trade Name or Brand	Town Where Collected	Total Metallic Arsenic		Water Soluble Arsenic	
			Found	Guaranteed	Found	Guaranteed
30622	Joseph Breck & Sons, Boston, Mass. Corona Colsenate (Powdered Calcium arsenate)	Skowhegan	26.87	28.00	1.11	0.75
30611	Brewer & Company, Worcester, Mass. Electro Arsenate of Calcium	Kingman	28.24	28.00	0.85	1.00
30628	The Glidden Company, Cleveland, Ohio Glidden Arsenate of Calcium	Calais	28.95	27.30	0.62	1.00
30596	John Lucas & Co., Boston, Mass. Lucas Dry Powdered Arsenate of Calcium	Bangor	23.80	26.00	0.99	0.75
30625	Nitrate Agencies Co., New York, N. Y. Calcium arsenate	Madison	26.00	26.00	0.26	0.75
30602	The Sherwin Williams Co., Cleveland, Ohio Dry Powdered Arsenate of Calcium	Bangor	21.45	27.00	0.96	2.70
30613	H. J. Smith & Co., Utica, N. Y. Smith Dry Powder Arsenate of Calcium	Sherman	25.63	27.30	1.08	1.00

LEAD ARSENATES

Station number.	Name and Address of Manufacturer or Jobber and Trade Name or Brand	Town Where Collected	Arsenic Oxide Total		Arsenic Oxide Water Soluble		Total Metallic Arsenic
			Found Per cent	Guaranteed Per cent	Found Per cent	Guaranteed Per cent	Found Per cent
30614	Bowker Insecticide Co., New York, N. Y. Bowkers' Dry Powdered Arsenate of Lead	Old Town	30.70	30.00	0.51	1.00	20.02
30605	Corona Chemical Co., Milwaukee, Wisconsin Corona Dry Arsenate of Lead	Dexter	30.90	30.00	0.79	0.75	20.15
30618	Devoe & Reynolds Co., New York, N. Y. Devoe Standard Arsenate of Lead	Orono	32.20	31.00	0.34	1.00	21.00
30635	General Chemical Co., New York, N. Y. Orchard Brand' Arsenate of Lead	Newport	32.10	30.00	0.28	0.98	20.93
30616	The Glidden Co., Cleveland, Ohio Glidden Dry Powdered Arsenate of Lead	Old Town	31.60	30.00	0.57	0.50	20.60
30633	Haskell Implement & Seed Co., Lewiston, Maine Grassette Arsenate of Lead Powder	Livermore Falls	32.00	30.60	0.28	0.50	20.86
30597	John Lucas & Co., Boston, Mass. Lucas Dry Powdered Arsenate of Lead	Bangor	31.20	30.00	0.28	0.75	20.35
30592	Merrimac Chemical Co., Boston, Mass. Swift's Dry Powdered Arsenate of Lead	Ellsworth	30.40	25.00	0.42	0.75	19.80
30623	Nitrate Agencies Co., New York, N. Y. Dry Arsenate of Lead	Madison	31.60	30.00	0.16	1.00	20.60
30619	Rice & Miller Co., Bangor Orchard Brand Arsenate of Lead	Orono	31.80	29.92	0.11	0.98	20.73
30601	The Sherwin Williams Co., Cleveland, Ohio Dry Powdered Arsenate of Lead	Bangor	31.10	30.00	0.23	1.00	20.28
	H. J. Smith & Co., Utica, N. Y.						
30606	Dry Powdered Arsenate of Lead	Dexter	32.50	31.00	0.16	0.50	21.19
30612	Smith's Arsenate of Lead Dry Powder	Sherman	20.35	31.00	0.55	1.00	13.27
30609	Snow & Nea'ly, Bangor, Maine Rogers' Dry Powdered Arsenate of Lead	Wytopitlock	31.70	30.00	0.57	1.00	20.67

MISCELLANEOUS INSECTICIDES AND FUNGICIDES

No. 30599. Bug Death Aphis. Manufactured by the Danforth Chemical Company, Leominster, Massachusetts. Claimed to contain Zinc oxide 15%, Lead oxide 1%, Sulphur 20%, Lime 20%, Tobacco Dust 10%, Inert 34%. Found by analysis to contain, Zinc oxide 21.80%, Lead oxide 5.61%, Sulphur 19.93%, Lime 18.56%, Tobacco dust, present.

No. 30598. Bug Death. Claimed to contain Zinc oxide 47%, Lead oxide 5%. Found by analysis to contain, Zinc oxide 47.76%, Lead oxide 7.36%.

No. 30629. Orchard Brand Arsenite of Zinc. Manufactured by the General Chemical Company, New York. Claimed to contain total metallic arsenic 30.5%, water soluble 1%. Found by analysis to contain, metallic arsenic 31.43%, water soluble 0.85%.

No. 30630. B. T. S. Orchard Brand. Claimed to contain, sulphur 33%. Found to contain, sulphur 34.45%.

No. 30603. Dry Lime Sulphur. Manufactured by the Sherwin Williams Co., Cleveland, Ohio. Claimed to contain 63% Calcium Polysulphide, 5% Calcium thiosulphide. Found to contain 62.96% total sulphur.

No. 30607. Sterlingworth He Bo. Manufactured by the Sterling Chemical Company, Cambridge, Mass. Claimed to contain 2% metallic arsenic, 3% water soluble. Found by analysis to contain, metallic arsenic 1.29%, water soluble 0.11%.

No. 30610. Watson's Soluble Arsenoid. Manufactured by John Watson & Company, Houlton, Maine. Claimed to contain, metallic arsenate 32.5%. Found by analysis to contain 40.22% metallic arsenic.

BORDEAUX AND ARSENIC MIXTURES

One pound of metallic copper equals about four pounds of blue vitriol (copper sulphate)

Station number.	Name of Manufacturer or Jobber and Trade Name or Brand	Town Where Collected	Metallic Arsenic		Water Soluble Arsenic		Metallic Copper	
			Found	Guaranteed	Found	Guaranteed	Found	Guaranteed
	Bowker Insecticide Co., Baltimore, Maryland							
30593	Bowker's Pyrox	Ellsworth	4.19	3.42	0.05	0.75	2.85	1.50
	Nitrate Agencies Co., New York, N. Y.							
30627	Kohbor Naco Brand	Calais	17.15	18.20	0.74	0.75	3.48	3.50
30626	Naco dust "A"	Madison	28.88	28.90	1.75	2.00	6.64	6.50

PREPARED BORDEAUX MIXTURES

Station number.	Name of Manufacturer or Jobber and Trade Name or Brand	Town Where Collected	Metallic Copper		Equivalent in Copper Sulphate Found
			Found	Guaranteed	
30620	Corona Chemical Co., Milwaukee, Wis. Corona Bordeaux Mixture Dry	Skowhegan	11.70	11.00	45.96
30631	General Chemical Co., New York, N. Y. Orchard Brand Bordeaux Mixture, Powdered	No. Jay	22.20	21.82	87.20
30634	The Glidden Co., Cleveland, Ohio Glidden Dry Powdered Bordeaux Mixture	Waterville	15.92	16.00	62.50
30624	Nitrate Agencies Co., New York, N. Y. Naco Bordeaux Mixture	Madison	12.62	13.00	49.50
30632	The Sherwin Williams Co., Cleveland, Ohio Fungi Bordo	Farmington	12.27		48.20
30604	Sterling Chemical Co., Cambridge, Mass. Liquid Bordeaux Mixture	Bangor	5.01	4.00	19.80